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AUTHOR DiBello, Louis V.; And Others
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ABSTRACT

This catalog presents brief descriptions of all lessons developed by the PLATO project for community colleges and adult education. One hundred six lessons are available for computer-based use. Topics range from elementary arithmetic to function theory and trigonometry. For each of these lessons, this catalog presents the title, code name, author, and a description of the lesson. Lesson descriptions include notations of grade and subject area, amount of student time and computer space needed, a statement of the lesson objectives, and a delineation of the lesson sequence. For most lessons, sample computer displays are pictured. Three programs which allow students to comment upon lessons and teachers to gain information concerning student progress are also provided. (SD)

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THE NATIONAL CENTER FOR
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1975

CATALOGUE OF
PLATO MATHEMATICS LESSONS
for Community Colleges
and Adult Education

compiled by

Louis V. DiBello
Tamar Abeliovich Weaver
Keith Bailey

Community College Mathematics Group

November 1975

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INTRODUCTION

The Community College Mathematics Project

It would take many pages to mention each person who has been involved in the development and implementation of the PLATO Community College Mathematics courseware. In most cases, the initial authoring of a PLATO lesson has been followed by cooperative review procedures involving instructors and PLATO staff, and by the collection and analysis of usage and lesson data. Special recognition is due to the following persons who have served as lesson authors, programmers and/or reviewers:

Peter Ash	Kennedy-King College, Chicago
Dan Anderson	Parkland College, Champaign
Keith Bailey	CERL, Urbana
Robert Baillie	CERL, Urbana
Dick Bennett	Parkland College, Champaign
James Bowery	Regional Health Resource Center, Urbana
Rose Brown	Kennedy-King College, Chicago
Steve Brayndick	Malcolm X College, Chicago
Donald Cohen	CERL, Urbana
Ruth Chabay	CERL, Urbana
Louis DiBello	CERL, Urbana
Sharon Dugdale	CERL, Urbana
Jerry Glynn	CERL, Urbana
Frances Kennedy	CERL, Urbana
David Kibbey	CERL, Urbana
David Lassner	CERL, Urbana
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Errol Magidson	Kennedy-King College, Chicago
LaVerne McFadden	Parkland College, Champaign
Allan Meers	Wright College, Chicago
Richard Neapolitan	Wright College, Chicago
Gary Peltz	Malcolm X College, Chicago
Carrol Steve Robinson	Chicago Urban Skills Institute, Chicago
Shin Saito	Malcolm X College, Chicago
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Noa Shinderman	Malcolm X College, Chicago
Donald Shirer	Valparaiso University, Valparaiso, IN
Martin Siegel	CERL, Urbana
Dan Sleator	CERL, Urbana
Paul Thompson	Parkland College, Champaign
Charles Weaver	CERL, Urbana
Tamar A. Weaver	CERL, Urbana
Mitsuru Yamada	Malcolm X College, Chicago

This project is part of the Community College Project directed by Daniel Alpert and coordinated by Pauline Jordan. It is the responsibility of the Community College Mathematics Group at CERL, Urbana, under the direction of Louis V. DiBello, to coordinate the development and implementation of the courseware, to collect and interpret formative data on the lessons,

and to keep the individual authors informed of the results of the data analyses. It is the responsibility of the individual authors to make needed revisions, to keep the lessons in working order, and to provide for the collection of data in their lessons. Usage of the mathematics lessons is facilitated by the PLATO site coordinators, Errol Magidson of Kennedy-King College, Mitsuru Yamada of Malcolm X College, Richard Neapolitan of Wright College, Elise Spencer Gorun and Carroll Steve Robinson of the Chicago Urban Skills Institute and Robert Grandey of Parkland College.

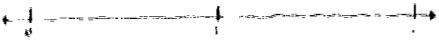
This Catalogue

This catalogue contains short descriptions of the PLATO lessons that are available under the Community College Mathematics Project. It should serve instructors as a guide for incorporating PLATO courseware into their teaching activities. On-line access to these lessons is available through the PLATO lesson "mathcc", which provides an updated index to all community college mathematics lessons, as well as an indication of their current status.

In an attempt to provide a clearer idea of what these PLATO lessons are, we have included photographs of various prints of selected screen displays. In many cases, screen displays in PLATO lessons are built up in a sequence of steps. New text or graphic parts of a display are often added after the student has responded to a question or otherwise indicated he is ready to proceed. To illustrate this process, and to show some of the interactive capabilities of the PLATO system, we have selected one frame from the fraction lesson "rfrac". Each stage in the development of the final screen display has been variously printed and photographed below. The reader should keep in mind that the various prints presented in the body of this catalogue usually represent an intermediate stage in the dynamic development of the screen displays.

The various prints below and on the next page show the steps involved in one exercise activity in the fraction lesson "frac". In the first four steps, the student's attention is directed to the correspondence between the denominator and the way in which the number line is divided.

Page 10
Let's locate some fractions with
denominator 4



Page 10
Let's locate some fractions with
denominator 4



How many parts should we divide
each unit into? 4

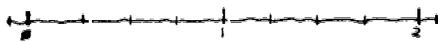
Page 10
Let's locate some fractions with
denominator 4



How many parts should we divide
each unit into? 4 ok

press NEXT to divide EACH unit into 4 equal parts.

Page 10
Let's locate some fractions with
denominator 4



How much of a unit is each part? $\frac{1}{4}$

page top

Let's locate some fractions with
denominator 4



How much of a unit is each part? 1/4 ok
Move the ↓ to 3/4

Use the ← or → keys to move the ↓
press, **ENTER** when you are done.

Now the student is asked to move a pointer to $3/4$. (Instructions are given at the bottom of the page.)

page top

Let's locate some fractions with
denominator 4



the ↓ is now at 2/4
press NEXT and keep trying

How much of a unit is each part? 1/4 ok
Move the ↓ to 3/4

Use the ← or → keys to move the ↓
press, **ENTER** when you are done.

When the student has moved the pointer and pressed **LAB**, he is given the current location of the pointer. Here, the pointer is at $2/4$ instead of $3/4$ so he must try again.

page top

Let's locate some fractions with
denominator 4



good, the ↓ is 3 fourths over from 0.

How much of a unit is each part? 1/4 ok
Move the ↓ to 3/4

Use the ← or → keys to move the ↓
press, **ENTER** when you are done.

Now the pointer was correctly moved to $3/4$. The point was then labeled. Next, the student would be asked to move the pointer to another fraction with denominator 4.

LESSON DESCRIPTIONS

File Name: speedway
Speedway

Author: Bonnie Anderson Seiler, Elementary Math Group, CERL

Indianapolis 500 First Race



6	6	4	5	7
x 6	+ 3	- 3	x 6	- 5
36 ok	9 ok	1 ok	30 ok	2 ok

The problem looks like this:

There are 4 groups of dots,
4 dots in each group.

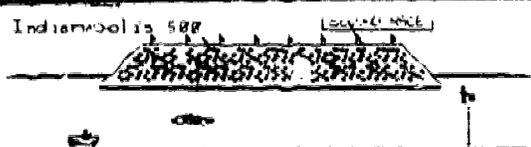
How many dots all together?

$$\begin{array}{r} 3 \text{ ok} \\ 6 \overline{) 18} \\ \underline{12} \\ 6 \end{array}$$

$$\begin{array}{r} 6 \\ + 1 \\ \hline 7 \text{ ok} \end{array}$$

$$\begin{array}{r} 4 \\ \times 4 \\ \hline 16 \end{array}$$

Indianapolis 500 Last Race



6	6	1	0
+ 2	x 1	x 5	x 6
8 ok	6 ok	5 ok	0 ok

GREAT! You had missed this one during another race today.

Press -HELP- for a picture of the problem

Objective:

Student quickly and accurately answers one-digit addition, subtraction, multiplication, and division problems.

Description:

1. Game format. The student works ten problems (for each "race") and wins if he beats his previous time.
2. Missed problems are repeated and difficulty level is adjusted according to performance.

Grade Level: Basic mathematics

Student Time: open

Subject Area: Arithmetic

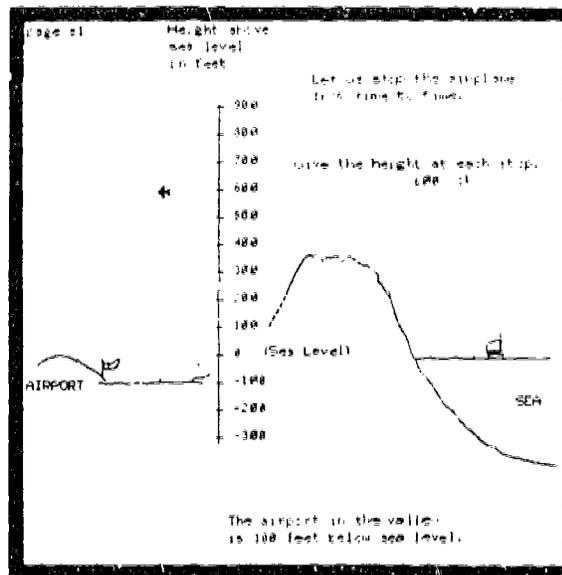
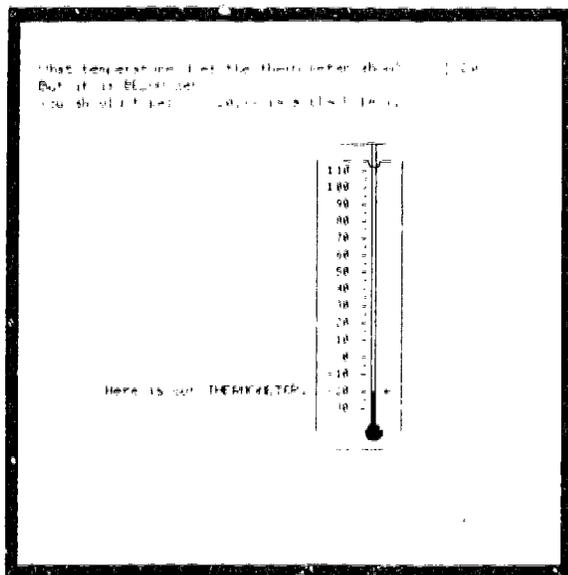
ecs: 6020

Special Notes:

The student is provided graphs and charts of his performance which he can use to decide where he needs more practice.

File Name: signex
Introduction -- Thermometer, Sea Level

Author: Tamar Abeliovich Weaver, CERL



Objective:

1. To present a quick and easy introduction to the number line and signed numbers by using temperature and sea level.

Description:

1. A pretest gives the student the chance to skip all or part of the lesson.
2. There are two sections: 1) temperature and 2) sea level. In each section the student sees a number scale (a thermometer in section 1 and a sea level scale in section 2) and answers several easy questions on reading scale values and differences between scale values.

Grade Level: Basic mathematics

Student Time: 5 - 10 minutes

Subject Area: Arithmetic

ecs: 1880

File Name: signum
Adding and Subtracting on the Number Line

Author: Tamar Abeliovich Weaver, CERL

page arrows

Solve this problem with the pointer:
 $2 + 6 = ?$

The number 2 is instead of 0. The number 6 is.

The pointer starts at 0.

Move the pointer to the first number in the problem.

Move the pointer to SUBTRACT the 6.

Where is the pointer now? $2 + 6 = ?$

So the pointer has 8. It is that $2 + 6 = 8$

HE 1

page arrows

Solve this problem with the pointer:
 $2 - 6 = ?$

The pointer starts at 0.

Move the pointer to the first number in the problem.

Move the pointer to SUBTRACT the 6.

Where is the pointer now? $2 - 6 = ?$

So the pointer has -4. It is that $2 - 6 = -4$

HE 1

Objectives:

1. To introduce the number line and the negative numbers.
2. To teach order on the number line.
3. To teach a number line model of adding and subtracting signed numbers.
4. To present practice problems on adding and subtracting signed numbers.

Description:

1. A pretest lets the student skip all or part of the lesson.
2. After a short introduction to the number line, the student is taught to move a pointer along the number line. The negative numbers are introduced as points that are integral distances to the left of 0.
3. Order on the number line is introduced (as $-2 > -5$).
4. Then the student is taught a number line model of adding and subtracting signed numbers. This arithmetic model is used to introduce each new type of signed number problem. Once each type is introduced, the student is given problems of that type until he can answer them correctly without help. The help consists of either stepping the student through with the number line model, or presenting a diagram of the problem on the number line.

Grade Level: Basic mathematics

Student Time: 45 minutes

Subject Area: Arithmetic

ecs: 5787

File Name: signum
 Adding and Subtracting on the Number Line

Author: Tamar Abeliovich Weaver, CERL

page sub:
 Solve this problem with the pointer:
 $4 - (-2) = ?$

You **ADDED** the (-2) . To subtract move to the right, (the reverse), the opposite, **NEST**.

The pointer starts at 0.
 Move the pointer to the first number in the problem.
 Move the pointer to **SUBTRACT** the $(-)$.

page sub:
 Solve this problem with the pointer:
 $4 + (-2) = ?$

Remember that the picture we had for $4 + 2$ had the same as this picture for $4 + (-2)$.

So $4 + (-2) = 4 + 2$

This will be true for any problem like this one. We said "minus minus is plus".

-NEXT-

ADDITION of numbers with the **SAME SIGN**.

Remember that $(-2) + (-4) = -6$ is to the left of 0
 and $2 + 4 = 6$ is to the right of 0.

A **RULE** you can use to add numbers with the same sign:

ADD the numbers without their sign and then put the **same** sign on the result.

SUBTRACTION IS THE REVERSE OF ADDITION.

To **ADD** a **NEGATIVE** number we move to the left, the direction of negative numbers.

Let's start with 3 and add (-2) , **NEST**.

So to **SUBTRACT** a **NEGATIVE** number we move to the right, the opposite direction, **NEST** to subtract the $(-)$.

ADD (-2) **SUB** (-2)

$3 + (-2) = 1$ $3 - (-2) = 5$

File Name: signadd
Addition of Signed Numbers

Author: Tamar Abeliovich Weaver, CERL

Objectives:

1. To introduce the number line and the negative numbers.
2. To teach order on the number line.
3. To teach a number line model of adding signed numbers.
4. To present practice problems on adding signed numbers.

Description:

1. A pretest lets the student skip all or part of the lesson.
2. After a short introduction to the number line, the student is taught to move a pointer along the number line. The negative numbers are introduced as points that are integral distances to the left of \emptyset .
3. Order on the number line is introduced (as $-2 > -5$).
4. Then the student is taught a number line model of adding signed numbers. This arithmetic model is used to introduce each new type of signed number problem. Once each type is introduced, the student is given problems of that type until he can answer them correctly without help. The help consists of either stepping the student through with the number line model, or presenting a diagram of the problem on the number line.

Grade Level: Basic mathematics

Student Time: 35 minutes

Subject Area: Arithmetic

ecs: 5880

Special Notes:

1. This lesson contains the parts of lesson "signum" that involve addition.
2. The sequence of lessons "signadd" and "signsub" is equivalent to lesson "signum", but the order of presentation of the topics is different.
3. Refer to the description of lesson "signum" for several screen displays that also occur in lesson "signadd".

File Name: signsub
Subtracting Signed Numbers

Author: Tamar Abeliovich Weaver, CERL

Objectives:

1. To teach a number line model of subtracting signed numbers.
2. To present practice subtracting and adding signed numbers.

Description:

1. A pretest lets the student skip all or part of the lesson.
2. The student is taught a number line model of subtracting signed numbers. The student gets exercises until he can do them without any help.
3. The help consists of either stepping the student through with the number line model, or presenting a diagram of the problem on the number line.

Grade Level: Basic mathematics Student Time: 25 minutes

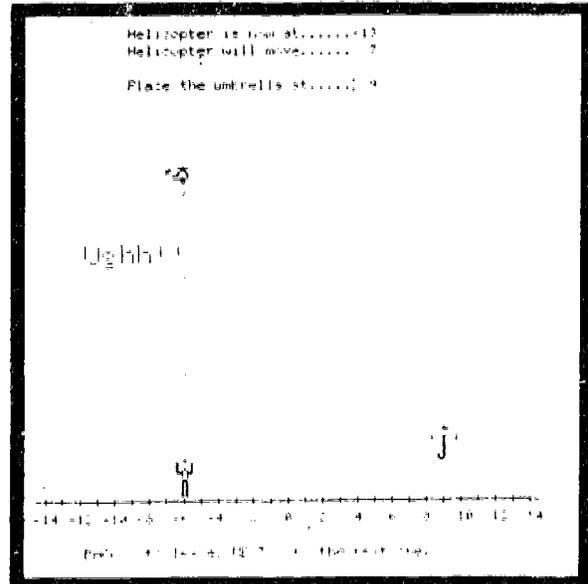
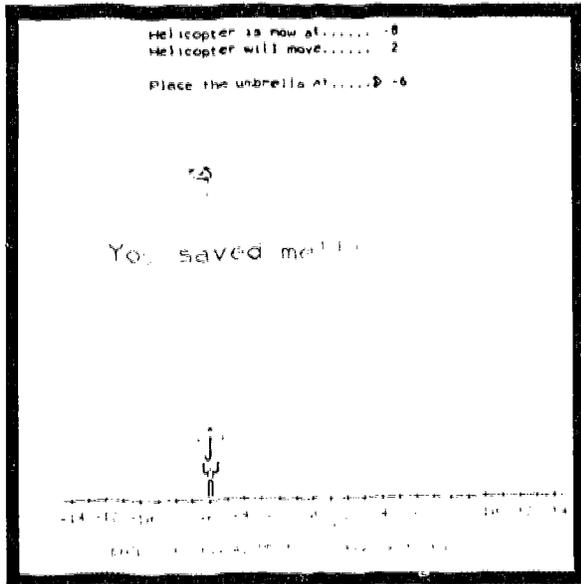
Subject Area: Arithmetic ecs: 4800

Special Notes:

1. This lesson should be preceded by lesson "signadd".
2. The sequence of lessons "signadd" and "signsub" is equivalent to lesson "signum", but the order of presentation of the topics is different.
3. Refer to the description of lesson "signum" for several screen displays that also occur in lesson "signsub".

File Name: ccegg
Eggdropper

Author: Mitsuru Yamada, Malcolm X College



Objective:

To provide practice in addition and subtraction of signed numbers.

Description:

The student specifies a move for a helicopter along the number line, or specifies the location of an umbrella on the number line. In both cases the helicopter drops an egg. Its target is a man on the number line.

Grade Level: Basic mathematics

Student Time: 5 - 10 minutes

Subject Area: Arithmetic

ecs: 742

File Name: signprac
Exercises -- Adding and Subtracting

Author: Tamar Abeliovich Weaver, CERL

Objective:

To provide drill practice in adding and subtracting signed numbers and a posttest for these skills.

Description:

1. Randomly generated problems in adding and subtracting signed numbers are given. The student must answer seven in a row correctly on first or second try. For help, the number line model prepared in lesson "signum" is used when the student calls for it.
2. A drill with "eggdropper" on the number line involves adding and subtracting signed numbers.
3. To finish the lesson the student has to go through a posttest for adding and subtracting signed numbers.
4. The student can choose any of the three sections in any order, and as often as he likes.

Grade Level: Basic mathematics

Student Time: 30 minutes

Subject Area: Arithmetic

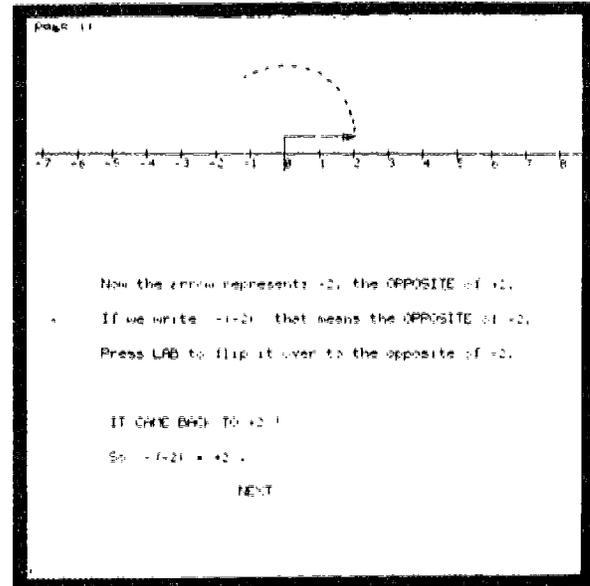
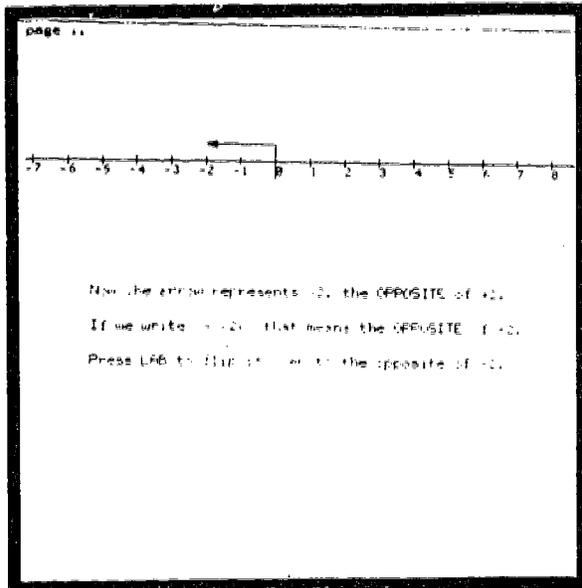
ecs: 3923

Special Notes:

This lesson should be used after lesson "signum".

File Name: signmult
Double Signs (Flipping) and Multiplication (Patterns)

Author: Tamar Abeliovich Weaver, CERL



Objectives:

1. To provide a concrete visual model for getting rid of double signs.
2. To provide a simple introduction to the rules for multiplying signed numbers.

Description:

There are two sections:

- a. Flipping: The student is given an arrow on the number line that represents a signed number. He can press LAB to flip the arrow about the origin and he is taught that this represents minus the original signed number. By using this flipping model the student is required to answer questions like $-(+3) = ?$ and $-(-2) = ?$, etc.
- b. Patterns: The student fills in the answers to:

$2 \times 2 =$		$2 \times (-2) =$
$1 \times 2 =$		$1 \times (-2) =$
$0 \times 2 =$	and then	$0 \times (-2) =$
$(-1) \times 2 =$		$(-1) \times (-2) =$
$(-2) \times 2 =$		$(-2) \times (-2) =$

These patterns provide an easy introduction to the rules
(negative) \times (positive) = (negative) and (negative) \times (negative) = (positive).

Grade Level: Basic mathematics

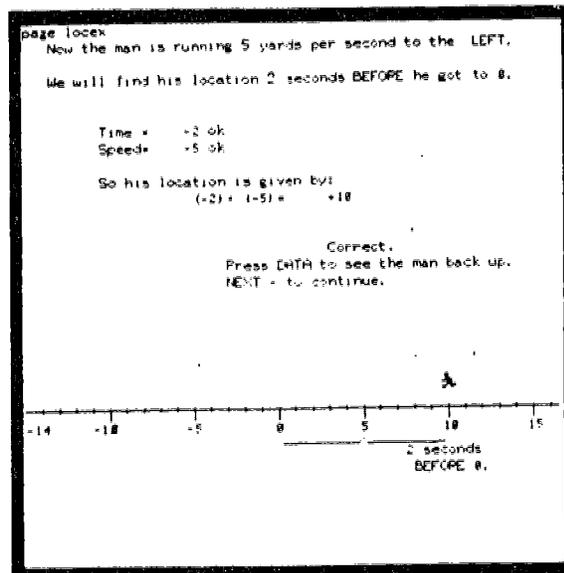
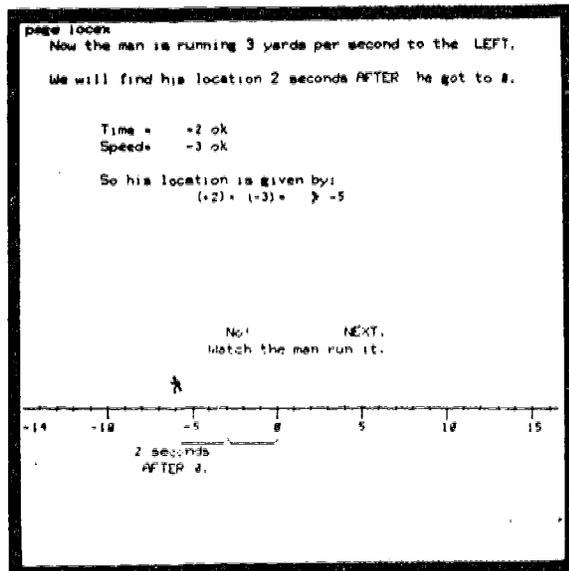
Student Time: 15 minutes

Subject Area: Arithmetic

ecs: 2370

File Name: run
Multiplication (using the running man)

Author: Tamar Abeliovich Weaver, CERL



Objective:

1. To teach multiplication of signed numbers by using a concrete visual model.

Description:

1. A pretest lets the student skip parts of the lesson.
2. A model of a man running along the number line is used to teach multiplication of signed numbers. His speed is positive or negative according to whether he runs to the right or left; his time is positive or negative according to whether it is after or before 0, and his position is interpreted as the product of speed and time.
3. Once the multiplication problems are introduced by using this model, more problems are presented without the model, and the model is used for help if the student needs it. The student works problems of each type until he can answer without asking for help.

Grade Level: Basic mathematics

Student Time: 45 minutes

Subject Area: Arithmetic

ecs: 4677

File Name: run
Multiplication (using the running man)

Author: Tamar Abeliovich Weaver, CERL

page 50

What does that have to do with multiplication of signed numbers?

For 2 seconds BEFORE the man gets to 0 we will say:

time = -2 This means 2 seconds BEFORE 0.
speed = 5 Means 5 yards per second to the RIGHT.

For 2 seconds BEFORE if we can back him up 2 times 5 yards:
So his location is given by: $(-2) \times (+5)$

What is the man's location? -10

So $(-2) \times (+5) = -10$

Press NEXT.

A number line from -14 to 15 with tick marks every 1 unit. A point is marked at -10. A bracket below the line spans from 0 to -10, labeled '2 seconds BEFORE 0'.

page 52

2 seconds after the man gets to 0 we will say:

time = +2 since it is 2 seconds AFTER 0.
speed = -5 since it is 5 yards per second to the LEFT.

He runs 2 times 5 yards to the LEFT.
So his location is given by: $(+2) \times (-5)$

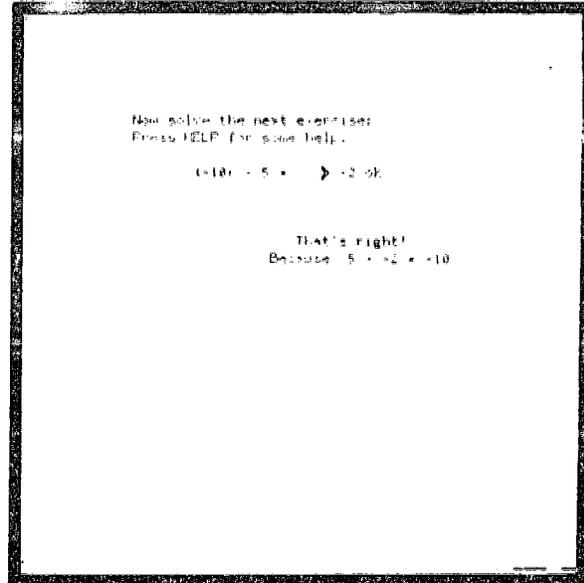
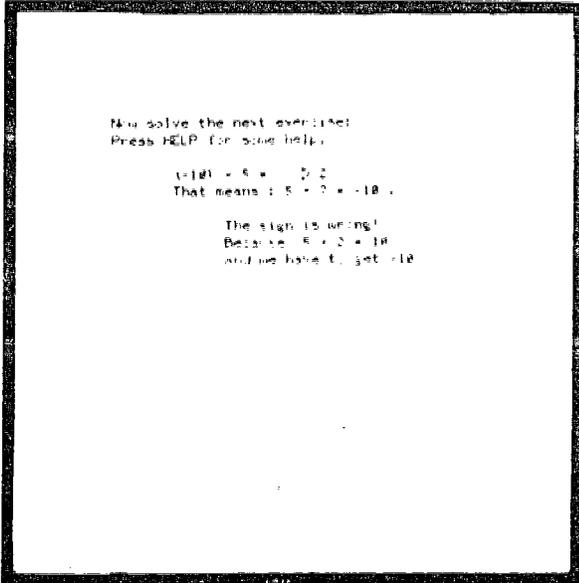
What is the man's location? -10 ok

So $(+2) \times (-5) = -10$

A number line from -14 to 15 with tick marks every 1 unit. A point is marked at -10. A bracket below the line spans from 0 to -10, labeled '2 seconds AFTER 0'.

File Name: divide
Division of Signed Numbers

Author: Tamar Abeliovich Weaver, CERL



Objective:

To present an introduction and practice on division of signed numbers.

Description:

1. Division is introduced as the inverse operation of multiplication, and multiplication is used as a check.
2. Sign rules for division are given as the same as those for multiplication.
3. As a help sequence, the student is sent to the section of lesson "run" that provides practice in finding the factors that yield a given product.

Grade Level: Basic mathematics

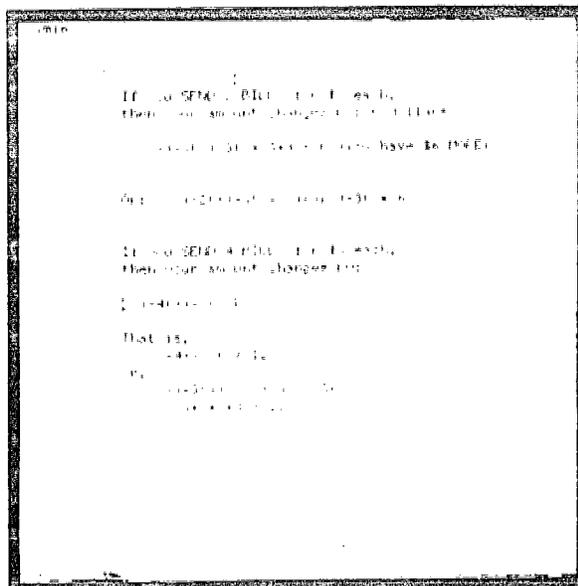
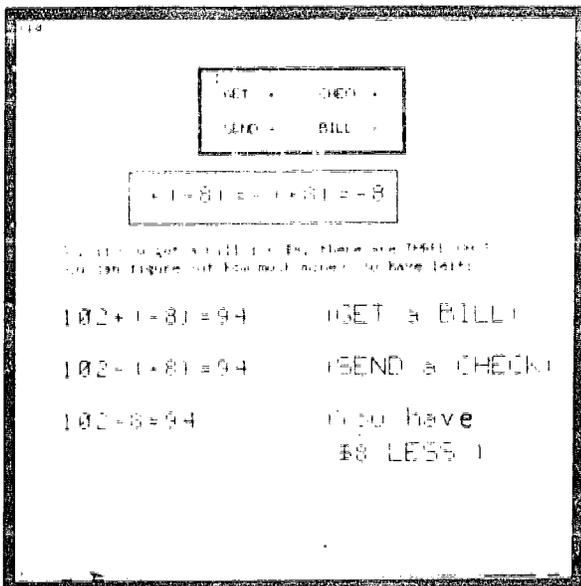
Student Time: 10 minutes

Subject Area: Arithmetic

ecs: 580

File Name: bank (jumps out to bank2)
Addition, Subtraction, and Multiplication of Signed Numbers.

Authors: Donald Cohen and Jerry Glynn, Elementary Math Group,
CERL
modified by Tamar Abeliovich Weaver and Robert
Baillie, CERL



Objective:

To teach arithmetic of signed numbers and provide practice in adding and multiplying signed numbers.

Description:

1. There are five sections:
 - a. Introduction -- checks and bills
 - b. Adding signed numbers
 - c. Addition exercises
 - d. Multiplying signed numbers
 - e. Multiplication exercises
2. In these lessons signed number arithmetic is modeled by sending or receiving checks or bills.
3. In sections b and d each arithmetic problem is associated with a story problem involving checks and bills.
4. In sections c and e a sequence of arithmetic problems without the money stories is given.

Grade Level: Basic mathematics

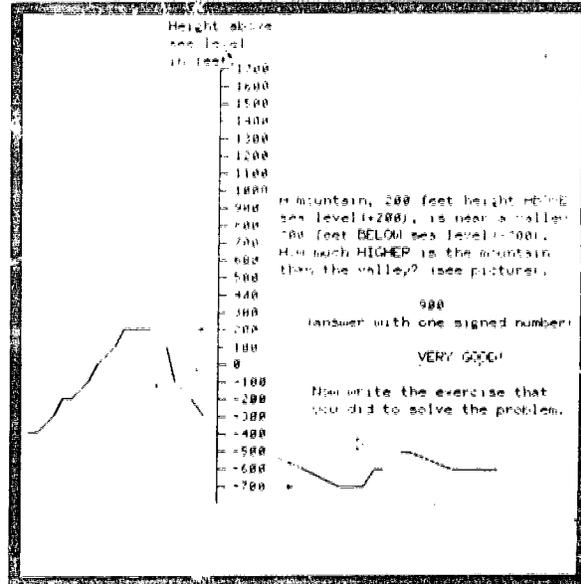
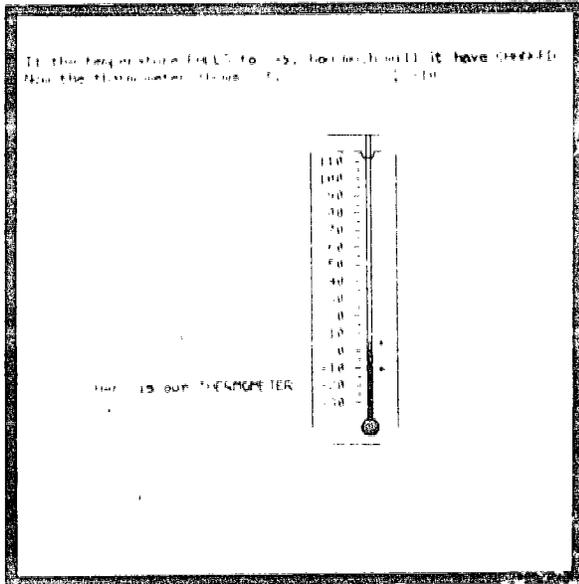
Student Time: 60 minutes

Subject Area: Arithmetic

ecs: bank 3481
bank2 1990

File Name: wordp
Signed Number Word Problems on Temperature and
Sea Level

Author: Tamar Abeliovich Weaver, CERL



Objective:

To practice word problems involving subtraction of signed numbers.

Description:

1. There are two types of problems:
 - a. Temperature Changes
 - b. Sea Level Differences
2. The student sees the picture of the problem and as feedback he sees what his response looks like.

Grade Level: Basic mathematics

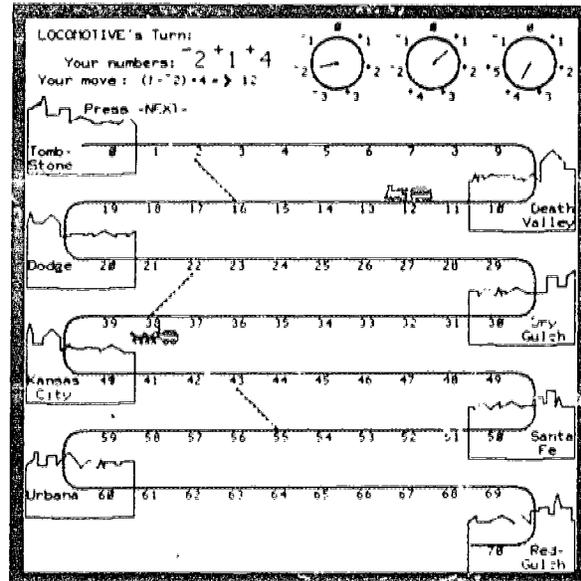
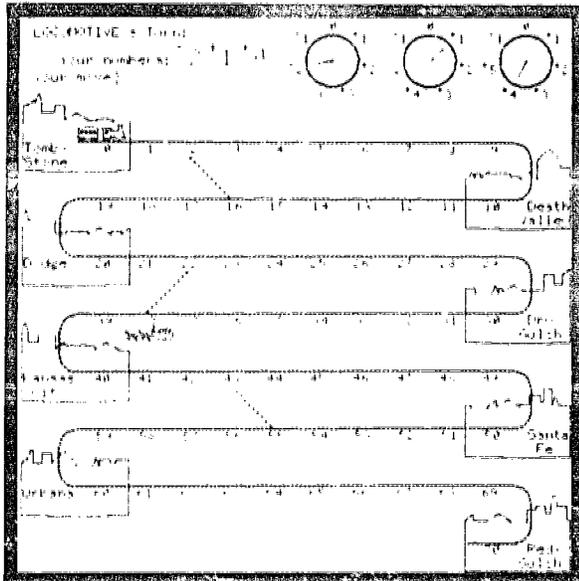
Student Time: 15 minutes

Subject Area: Arithmetic

ecs: 1736

File Name: west2
Signed Numbers Game -- West

Author: Bonnie Anderson Seiler, CPERL Elementary Math Group



Objective:

To provide practice in a game format in combining signed numbers by using the four arithmetic operations with or without parentheses.

Description:

1. The game consists of a race between a stage coach and a locomotive. The student plays against another student or against PLATO.
2. Moves are made by combining three signed numbers using the four arithmetic operations.

Grade Level: Basic mathematics

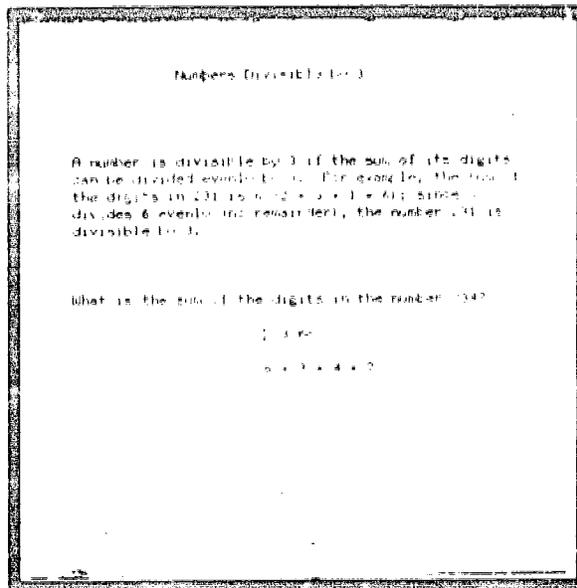
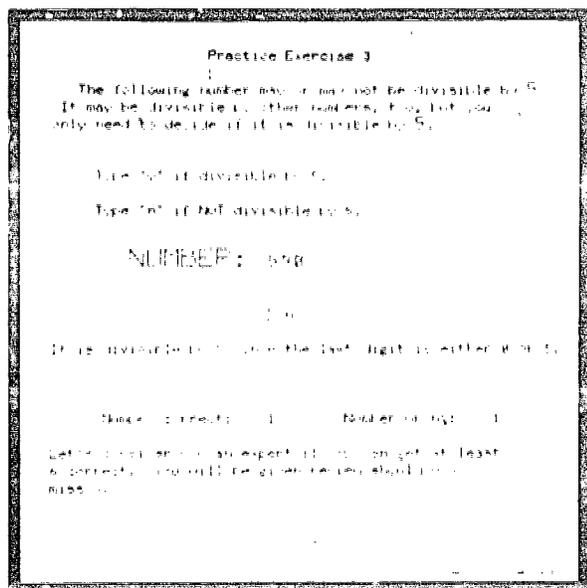
Student Time: 15 minutes

Subject Area: Arithmetic

ecs: 5700

File Name: divvr
Divisibility Rules/Reducing Fractions

Author: Errol Magidson, Kennedy-King College



Objectives:

1. To teach the student the rules for divisibility by 2, 3, 5, 10, 4, 6, 9 and to drill the student in their use.
2. To teach the student to use these divisibility rules in reducing fractions.

Description:

- There are eight sections:
- a. Numbers divisible by 2
 - b. Numbers divisible by 3
 - c. Numbers divisible by 5
 - d. Numbers divisible by 10
 - e. Reducing fractions quickly
 - f. Numbers divisible by 4
 - g. Numbers divisible by 6
 - h. Numbers divisible by 9

Grade Level: Basic mathematics

Student Time: 60 minutes

Subject Area: Arithmetic

ecs: 4118

Special Notes:

Optional topic: Finding the Greatest Common Divisor

File Name: gcd
Finding the Greatest Common Divisor

Author: Errol Magidson, Kennedy-King College

A method for finding the GCD was developed by the ancient Greek mathematician, Euclid. Here is how you can find the GCD of any fraction:

Fraction: $\frac{24}{42}$

First, divide the SMALLER number into the LARGER.

Second, if your remainder is NOT zero, divide your remainder into the DIVISOR of the problem you just worked.

Third, continue to divide the remainder into the divisor until you end up with a zero remainder. When this happens your last divisor is the GCD!

①
$$\begin{array}{r} 1 \\ 42 \overline{) 24} \\ \underline{24} \\ 0 \end{array}$$

remainder: 0
divisor: 42

②
$$\begin{array}{r} 1 \\ 24 \overline{) 18} \\ \underline{24} \\ 18 \end{array}$$

remainder: 18
divisor: 18

③
$$\begin{array}{r} 3 \\ 18 \overline{) 18} \\ \underline{18} \\ 0 \end{array}$$

remainder: 0
divisor: 18

Practice Exercise

Find the greatest common divisor (GCD) with PLATO's help. Just tell PLATO what you want calculated. For example, if you want PLATO to divide 5 into 22, request: 22 ÷ 5 or 22 / 5.

Press **END** when you know the GCD.

Original Fraction: $\frac{236}{413}$

END available

Your request: ÷ Type your GCD: :

Number correct: 0 Number of requests: 1

Let's cheer for you as expert as you can get. At least 4 correct, you will be given a review about how to make 3 more tries.

Objective:

The student will be able to find the greatest common divisor of any fraction so he can reduce it when possible.

Description:

1. Introduction
2. PLATO reduces student-constructed fractions
3. Practice exercise/test

Grade Level: Basic mathematics

Student Time: 60 minutes

Subject Area: Arithmetic

ecs: 2141

File Name: primefac
Prime Factorization of Whole Numbers

Author: Keith Bailey, CERL

You have 4 problems to go.

If the given number is not prime, we will factor it.

Are all of your factors prime? n o

Choose a factor which is not prime o k

Write 6 as a product of two smaller natural numbers. $6 = 3 \times 2$

We will keep track of our work here.

12

$12 = 6 \times 2$

You have 4 problems to go.

If the given number is not prime, we will factor it.

Are all of your factors prime? y e s

so you are done

We will keep track of our work here.

12

$12 = 6 \times 2$

$12 = 3 \times 2 \times 2$

This is the Prime Factorization of 12.

Objective:

To teach how to find the prime factorization of natural numbers and to teach the definition of prime numbers.

Description:

1. (section a) Definition of factor with exercises.
2. (section b) Definition of prime.
3. (section c) The student is stepped through the process of finding prime factorizations.
4. (section d) The student is asked to give the prime factorization and can use several steps.
5. (section e) Quiz over the above topics. The student must pass this quiz to complete the lesson.
6. (section f) The student can choose any natural number from 2 to 10,000 and the prime factorization will be given to him.

Grade Level: Elementary algebra

Student Time: 35 minutes

Subject Area: Algebra

ecs: 3170

Special Notes:

Each section can be accessed from an index. If the student fails the quiz, appropriate sections for review are noted on this index.

File Name: claim
Claim Game

Authors: Charles Weaver, CERL, and Bonnie Anderson Seiler,
CERL

CLAIM GAME					
Tamar's score 06		Plato's score 31			
<u>Numbers picked</u>	2	3	4	5	6
07	8	9	10	11	12
29	14	15	16	17	18
	20	21	22	24	26
	28	27	25	19	
	12	13	14	15	16
<u>Tamar's turn</u>					
	What number do you want to pick from the board? > 11				
<u>Plato's claim</u>					
	Plato claims that 11 is a factor of 66.				
	Please click on the right button.				

CLAIM GAME					
Tamar's score 24		Plato's score 45			
<u>Numbers picked</u>	2	3	4	5	6
07	8	9	10	11	12
29	14	15	16	17	18
	20	21	22	24	26
	28	27	25	19	
	12	13	14	15	16
<u>Plato's turn</u>					
	Plato picks the number 11 from the board.				
<u>Tamar's claim</u>					
	Plato's score is 45. Is this a factor of 24? > 1				
	Use the numbers on board to claim. Press <Left> when you are finished.				
	> 11 > 11 > 11				

Objective:

To practice factoring natural numbers.

Description:

1. The game is for two players either two friends or a student against PLATO. The two players take turns picking numbers from the board (see figures above). As each number is picked, it is removed from the board and added to the player's score.
2. His opponent may then increase his own score by CLAIMING the numbers on the board that are factors of the original number. When all numbers have been removed from the board, the player with the highest score wins.

Grade Level: Basic mathematics

Student Time: 15 minutes

Subject Area: Arithmetic

ecs: 2272

Special Notes:

PLATO plays poorly against poor players.

File Name: frint
Introduction to Fractions

Author: Keith Bailey, CERL

PIC

Find what fraction is represented by the picture.



Type in the denominator.

Right. Each square is cut into 3 equal parts.

Now type in the numerator.

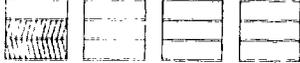
Creating Fractions

Which fraction is larger, $\frac{1}{2}$ or $\frac{2}{3}$?
Cut the fractions into equal parts. Type in

$\frac{1}{2}$ = $\frac{\quad}{\quad}$



$\frac{2}{3}$ = $\frac{\quad}{\quad}$



Objective:

To introduce the concept of a fraction and to teach the distinction between the numerator and denominator of a fraction.

Description:

1. The student is taught to represent a fraction by divided and shaded squares -- e.g., to represent $\frac{4}{5}$, divide each square in the group into five equal parts and shade four of the equal parts.
2. The student is asked to represent a given fraction and also to give the fraction represented by a given picture of shaded squares.
3. Once this representation has been learned, the student uses it to compare fractions and to add fractions with like denominators.

Grade Level: Basic mathematics

Student Time: 60 minutes

Subject Area: Arithmetic

ecs: 3194

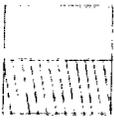
File Name: frdrill
Equal Fractions

Author: Keith Bailey, CERL

page 233

RULE: If we multiply the numerator and denominator of a fraction by the same number (except 0), we get an equal fraction.

This time we will see why $1/2 = 2/4$.



The square is cut into 2 equal parts.

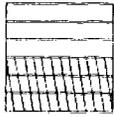
Into how many parts should we cut each of these to get a total of 6 parts?

How many of these parts are shaded?

page 234

RULE: If we multiply the numerator and denominator by the same number (except 0), we get an equal fraction.

This time we will see why $1/2 = 3/6$.



The square is cut into 6 equal parts.

Into how many parts should we cut each of these to get a total of 6 parts?

How many of these parts are shaded? $\rightarrow 3$

Right, $3/6 = 3$ parts are shaded.

$$\frac{1}{2} = \frac{3}{6}$$

Objective:

To provide instruction in writing equal fractions.

Description:

1. The rule $\frac{n}{d} = \frac{n \times c}{d \times c}$ is derived by multiplying $\frac{n}{d}$ by $\frac{c}{c}$, a fraction equal to 1. This rule is drilled in several different ways, then the student builds a table of common fraction equalities such as $1/2 = 2/4$, $1/3 = 2/6$, etc.
2. The notion of factor is introduced and used for reducing fractions.
3. A drill is given in which the student is asked to write a fraction with a given denominator equal to a given fraction -- e.g., $2/3 = ?/12$.

Grade Level: Basic mathematics

Student Time: 60 minutes

Subject Area: Arithmetic

ecs: 4236

File Name: rfrac
Fractions on the Number Line

Author: Keith Bailey, CERL

page 1 of 10
Let's locate some fractions with denominator 4



How many parts should we divide each unit into? 4 ok

press NEXT to divide EACH unit into 4 equal parts.

page 1 of 10
Let's locate some fractions with denominator 4



How much of a unit is each part? 1/4 ok

Move the ↓ to 3/4

Use the ← or → keys to move the ↓
press, [ENTER] when you are done.

Objectives:

1. To teach how to locate fractions on the number line.
2. To show how this model can be used for comparing fractions, determining equivalent fractions, converting improper fractions to mixed numbers.
3. To demonstrate the relationship between division and fractions.

Description:

1. (sections a - e) The number line is introduced and, for a given fraction, the student is asked how to subdivide each unit length and then move a pointer to locate the fraction. Given a subdivided numberline, the student is asked to use a fraction to give the location of the pointer.
2. (section f) A labeled numberline for a certain denominator is given. The student is asked to move the pointer to locate fractions whose denominators are multiples of the first denominator.
3. (section g) The student can choose two denominators and the corresponding labeled number lines are shown for comparison.
4. (section h) For an improper fraction on the number line, the student is asked to give the corresponding mixed number.
5. (section i) The relationship between division and fractions is demonstrated.

Grade Level: Basic mathematics

Student Time: 40 minutes

Subject Area: Arithmetic

37

ecs: 3707

File Name: fracprac
Exercises -- Arithmetic Operations on Fractions

Author: Keith Bailey, CERL
programmed by David Lassner, CERL

PRACTICE

$$\frac{1}{3} - \frac{1}{4} = \dots$$

Write the fraction for the difference.

Do not use the fraction bar.

1. Subtract the fractions.

2. $\frac{1}{3} - \frac{1}{4} = \dots$

3. $\frac{1}{4} - \frac{1}{3} = \dots$

4. $\frac{1}{3} - \frac{1}{4} = \frac{\dots}{12}$

HELP to step through DATA for the rule ERIC for the rules

PRACTICE

$$\frac{2}{1} + \frac{1}{3} = \dots$$

Write the fraction for the sum.

Do not use the fraction bar.

1. Add the fractions.

2. $\frac{2}{1} + \frac{1}{3} = \dots$

3. $\frac{2}{1} + \frac{1}{3} = \frac{\dots}{3}$

4. $\frac{2}{1} + \frac{1}{3} = \frac{\dots}{3}$

HELP to step through DATA for the rule ERIC for the rules

Objective:

To provide drill practice and checkup quiz on the four arithmetic operations on fractions.

Description:

1. There are six sections:
 - a. Addition of Fractions with Like Denominators
 - b. Subtraction of Fractions with Like Denominators
 - c. Multiplication of Fractions
 - d. Division of Fractions
 - e. Addition and Subtraction of Any Fractions
 - f. Mixed Exercises
2. Each section has three options:
 - a. Instruction: a brief statement of the appropriate rule, and a typical problem of the given type that the student is stepped through.
 - b. Practice: five problems of the given type -- at any time the student can press DATA to get the rule on the screen or HELP to step through his problem.
 - c. Checkup: a quiz of six problems. The student has mastered the section if he answers five correctly out of six.

Grade Level: Basic mathematics

Student Time: 60 minutes

Subject Area: Arithmetic

ecs: 3446

File Name: fracfun
Exercises -- Equal Fractions; Mixed Numbers

Author: Keith Bailey, CERL
programmed by David Lassner, CERL

PRACTICE

Write $5/4$ as a mixed number.

$5/4 = ?$

Rule: To write a fraction greater than 1 as a mixed number:

- 1) Divide the numerator by the denominator.
- 2) Write the whole number + the remainder over the denominator.

- 1) First, divide 5 by 4.
What is the whole number? 1 ok
What is the fractional part? 1/4 ok
- 2) Now type the mixed number: 1 1/4 ok.
Be sure to use the x sign!

[HELP](#) to step through [RULE](#) for the rule [DATA](#) for the index

QUIZ

Type 'd' if the fraction is in lowest terms, otherwise reduce it.

$\frac{2}{4} = 1/2$ good

$\frac{7}{21} = 1/3$ good

$\frac{9}{12} = 3/5$ no, an answer is 3/4.

$\frac{8}{12} = 4/8$ yes, which can be reduced to 2/3.

$\frac{25}{50} = 5/10$ yes, which can be reduced to 1/2.

CONGRATULATIONS! You have mastered this section.

[DATA](#) to return to the index

Objective:

To provide drill practice and checkup quiz in reducing fractions, writing equal fractions and mixed number conversions.

Description:

1. There are three sections:
 - a. Reducing Fractions
 - b. Writing an Equal Fraction
 - c. Mixed Number Conversions
2. Each section has three options:
 - a. Instruction: a brief statement of the appropriate rule, and a typical problem of the given type which the student is stepped through.
 - b. Practice: five problems of the given type -- at any point the student can press DATA to get the rule on the screen, or HELP to step through the given problem.
 - c. Checkup: a quiz of six problems. The student has mastered the section if he gets five correct out of the six.

Grade Level: Basic mathematics

Student Time: 15 minutes

Subject Area: Arithmetic

ecs: 3887

File Name: reduce
Exercises -- Reducing Fractions

Author: Mitsuru Yamada, Malcolm X College

Reduce the following fraction to lowest terms by inspection.

$$\frac{24}{96} = \frac{12}{48}$$

common divisor... 12

DATA

a. For directions on how to reduce by inspection, press DEFINITIONS.

OP...

First common divisor... 12

Reduce the following fraction to lowest terms by inspection.

$$\frac{24}{96} = \frac{12}{48}$$

common divisor... 12

TYPE...

a. For directions on how to reduce by inspection, press DEFINITIONS.

OP...

First common divisor... 12

Objective:

To provide practice in reducing fractions.

Description:

1. There are two sections:
 - a. PLATO selects the fraction to be reduced.
 - b. The teacher selects the fraction to be reduced.
2. In both sections, once the fraction is given, the student is asked to name a common divisor of the numerator and denominator, then to reduce the fraction by that divisor. Definitions of terminology are available by pressing DATA.
3. The student may work as many problems as he wants in either section.

Grade Level: Basic mathematics

Student Time: 30 minutes

Subject Area: Arithmetic

ecs: 1650

File Name: lcd
Adding and Subtracting Fractions with Unlike Denominators

Author: Errol Magidson, Kennedy-King College

$\frac{4}{3} + \frac{5}{6} + \frac{3}{4}$

Let's take your common denominator and use it to help solve our problem.

1st, divide the denominator of the original fraction into our common denominator.

What is your QUOTIENT in the 1st problem? 4 ok

2nd, multiply your QUOTIENT by the NUMERATOR in the original fraction.

This is your NEW numerator.

NUMERATOR

$\frac{(1)4}{3} = \frac{4}{12}$

$\frac{5}{6} = \frac{10}{12}$

$\frac{3}{4} = \frac{9}{12}$

Practice Exercise 4

Solve these problems as requested below.

Problem: $4.6 + 1.4 + 2.3$

You may skip this problem here (DON'T put your final answer here). Press **SKIP** to skip this.

2 3 4 3 3 3

Find a common denominator.

12 12 12

10 12 12 12

Go on right, Thank.

Number correct: 1 Number wrong: 0

Let's consider you an expert if you can get at least 10 correct. You will be given review about this time.

Objective:

To teach the student how to add or subtract fractions with unlike denominators.

Description:

1. There are four sections:
 - a. Steps to Finding a Solution
 - b. Finding a Common Denominator
 - c. Finding the New Numerators
 - d. Having PLATO solve student-constructed problems
2. Pre- and posttest are available.

Grade Level: Basic mathematics

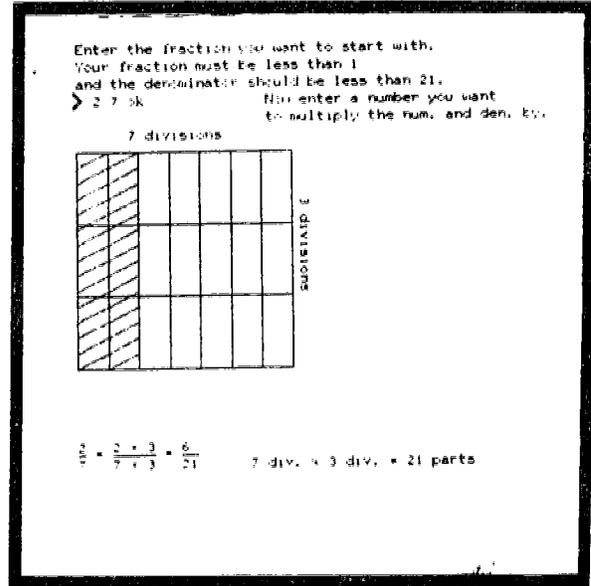
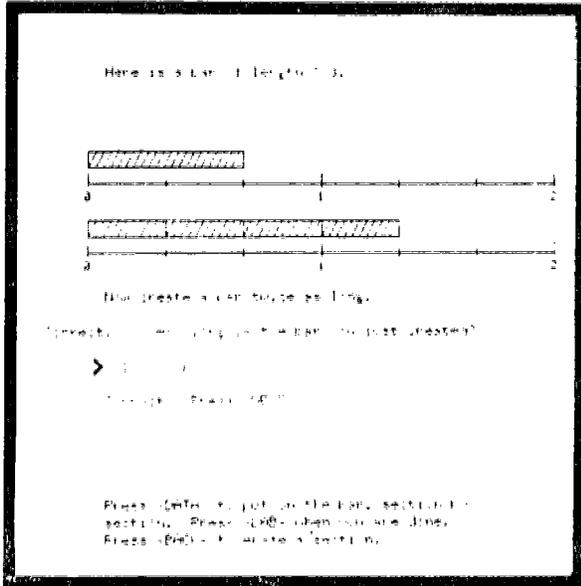
Student Time: 40 minutes

Subject Area: Arithmetic

ecs: 5006

File Name: frac2
Graphic Experiments with Fractions

Author: Keith Bailey, CERL



Objective:

To use squares, rectangles, and the number line to develop an understanding of fractions.

Description:

1. (section a) A divided square is used to show equivalent fractions.
2. (section e) Lists of equivalent fractions are generated for the student's choice of two fractions. This can be used for finding common denominators.
3. (section f) The student is asked to subdivide unit lengths on the number line so that a bar can be measured.
4. (sections b, c, d, g) The student uses the number line to draw and measure rectangular bars.

Grade Level: Basic mathematics

Student Time: open

Subject Area: Arithmetic

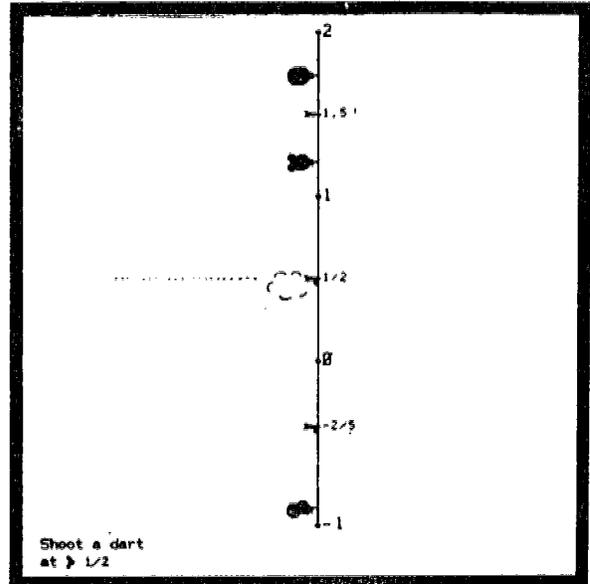
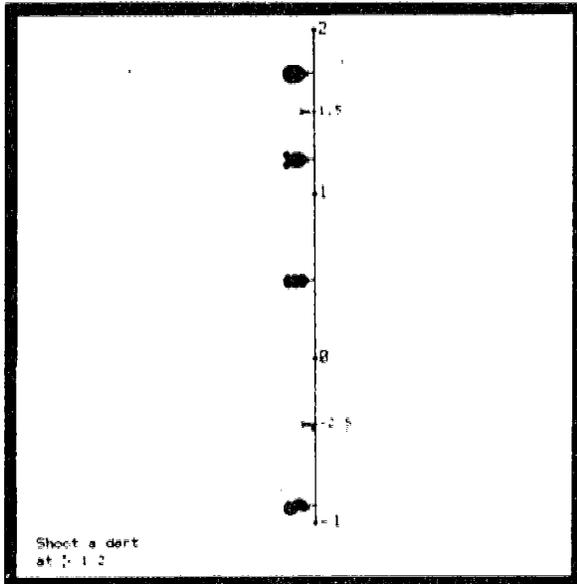
ecs: 2984

Special Notes:

This lesson is not ready for classroom use and is only intended for pilot testing some ideas.

File Name: darts
Dart Game

Authors: Sharon Dugdale, David Kibbey, Elementary Math Group,
CERL



Objective:

To provide practice in locating fractions on the number line.

Description:

1. A vertical number line with several balloons at different locations is displayed. Only integer points on the line are labeled.
2. The student enters a fraction or expression and a dart is shot to that location. If any part of the balloon is touched by the dart, the balloon "bursts."
3. The student's task is to break all the balloons.

Grade Level: Basic mathematics

Student Time: open-ended

Subject Area: Arithmetic

ecs: 4935

Special Notes:

The number line and the size of the balloons vary depending on the performance of the student.

File Name: ratios
Introduction to Ratios

Author: Barbara Lederman, Community College Math Group

WORDS: ratio of 3 to 4

NUMBERS: fractional form: $\frac{3}{4}$
form using colon: 3:4

QUICK drill:
Write the following ratios in WORDS:

5 : 6

ratio of 5 to 6 good

One automobile has an engine of 90 horsepower.
A second has an engine of 75 horsepower.
What is the ratio of the horsepower of the
first to the horsepower of the second?

90/75 ok

Betty has \$12 and Lou has \$18.
What is ratio of Lou's money to
Betty's money?

18:12 ok

The radius of one circle is 5 units;
the radius of a second circle is 10.
What is the ratio of the circumference
of the first to the circumference of
the second?
(HINT: $C = 2\pi r$)

> 1:2 ok

Verrrrrry good

Objective:

To provide a short introduction to ratios.

Description:

Introduction to ratios: notation, terminology, writing ratios,
expressing ratios in lowest terms.

Grade Level: Basic mathematics

Student Time: 10 minutes

Subject Area: Arithmetic

ecs: 2800

File Name: dec
Decimal Skills: Introduction

Author: Errol Magidson, Kennedy-King College

Objective:

To provide an overall rationale, set of objectives and index to lessons dec1, dec2, dec3, dec4, and ckbk.

Description:

This lesson contains four sections:

- a. Rationale for decimals lessons
- b. Lesson objectives
- c. Definition of "decimal"
- d. The index for the decimal lessons

Grade Level: Basic mathematics Student Time: 10 minutes

Subject Area: Arithmetic ecs: 1500

File Name: dec1
Reading and Writing Decimals

Author: Errol Magidson, Kennedy-King College

OBJECTIVE:
The place value of the last digit in the decimal
is always one-tenth of the place value of the
digit to its left.

	4	5	6	7	8	9
1000's						
100's						
10's						
1's						
Tenths						
Hundredths						
Thousandths						

What is the place value of the digit 7?
Tenths

What is the place value of the digit 9?
Hundredths

Place Value Exercise 1

PLACING number	YOUR answer
Example: 0.4	tenths

As in the example above, what is the place value of
the last digit in the following decimal?

(Decimal) 41,098217

Beautifully done!

Number of corrects: 1 Number of mistakes: 0

Let's consider you an expert. If you can get 5
in a row correct before making 3 mistakes, otherwise
you will be given a review.

Objective:

1. To enable the student to read and write decimals using place and point methods.

Description:

1. There are five major sections:
 - a) Introduction
 - b) Reading the place value chart
 - c) Relationship between place value and fractional size
 - d) Reading decimal numbers (place and point methods)
 - e) Writing a decimal number
2. In addition there are pre- and posttests in this lesson.
3. Each section has instruction and exercises.

Grade Level: Basic mathematics

Student Time: 60 minutes

Subject Area: Arithmetic

ecs: 5712

File Name: dec2
Adding and Subtracting Decimals

Author: Errol Magidson, Kennedy-King College

Here is another exercise:

$$48.1 - 32.321$$

$$\begin{array}{r} 48.100 \\ - 32.321 \\ \hline \end{array}$$

Since the second number is 21
digits more digits to the
right of the decimal point than
the first, 48.100 should
add two zeros to the
first number.

Now, we don't have to change the value of 48.1.
48.100 has the same value as 48.1. Now we can subtract.

Here is another kind of subtraction problem:

$$314 - 5.2$$

$$\begin{array}{r} 314 \\ - 5.2 \\ \hline \end{array}$$

Objective:

To enable students to add and subtract decimals.

Description:

1. There are three major sections:
 - a. Lining up decimals for adding and subtracting
 - b. Adding decimals
 - c. Subtracting decimals
2. In addition, there are pre- and posttests.
3. Each section has instruction and exercises.

Grade Level: Basic mathematics

Student Time: 60 minutes

Subject Area: Arithmetic

ecs: 5278

File Name: dec3
 Multiplying and Dividing Decimals

Author: Errol Magidson, Kennedy-King College

Practice Exercise 1

How many places after the decimal point will be in the product of these numbers?

Problem	Product
795.7×887.3	70602461

Press -HELP- if you can't find the answer.

Number in a row correct: 0 Number of mistakes: 0

Let's consider you an expert if you can get 5 in a row correct. You will be given help should you miss 3.

Practice Exercise 2

Insert the decimal point in the correct place:

Problem	Product
159	$.188 \overline{) 2.9892}$

Press -HELP- if you can't find the answer.

Press -> to move the cursor to the place you want to insert your decimal point
 Press -ERASE- to start over -HELP- available
 Press -DEC- to insert your decimal point

Number in a row correct: 0 Number of mistakes: 0

Let's consider you an expert if you can get 4 in a row correct. You will be given help should you miss 3.

Objective:

To enable the student to multiply and divide decimals.

Description:

1. There are two major sections:
 - a. Multiplication of Decimals
 - b. Division of Decimals
2. Each section has instruction and exercises.
3. There are pre- and posttests.

Grade Level: Basic mathematics

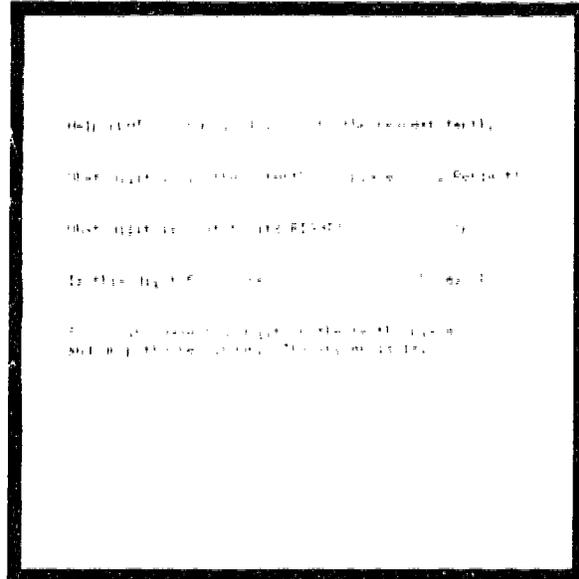
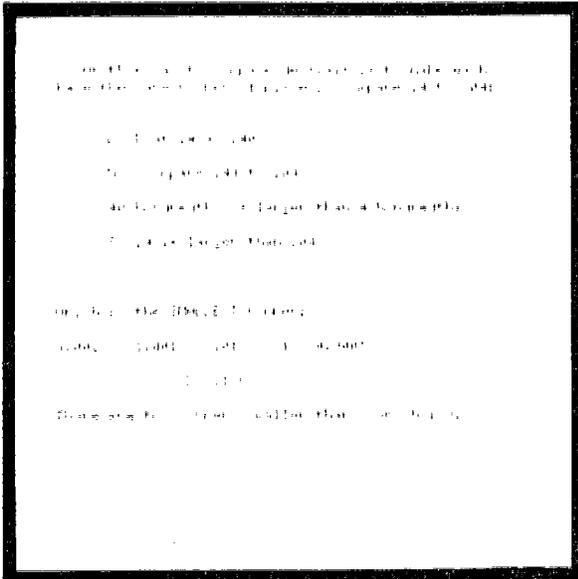
Student Time: 60 minutes

Subject Area: Arithmetic

ecs: 5911

File Name: dec4
Rounding and Comparing Decimals

Author: Errol Magidson, Kennedy-King College



Objectives:

1. To enable the student to round off decimals.
2. To enable the student to convert fractions or mixed numbers to decimals and vice versa.
3. To enable the student to compare decimals and fractions.

Description:

1. There are five major sections:
 - a. Rounding off decimals
 - b. Changing fractions to decimals
 - c. Changing mixed numbers to decimals
 - d. Changing decimals to fractions
 - e. Comparing fractions and decimals
2. Each section contains instruction and exercises. The lesson contains pre- and posttests.

Grade Level: Basic mathematics

Student Time: 60 minutes

Subject Area: Arithmetic

ecs: 5963

File Name: ckbk
Keeping a Balanced Checkbook

Author: Errol Magidson, Kennedy-King College

PLATO: INT144L: BWA
Checking Account for Toner

Check Number	Date	Made out to	Balance
			\$50.12
	1/4		Deposit 71.27
			New Bal. 121.39
		Writ. Check	
			New Bal.

So what is your new balance? (Figure it out on PLATO. You need help if you make 2 mistakes in addition.)

Do not forget the decimal point. Please keep your answer in line with your other numbers.

Press <HELP> if you don't find your balance.

PLATO: INT144L: BWA
Checking Account for Toner

Check Number	Date	Made out to	Balance
			\$50.12
	1/4		Deposit 71.27
			New Bal. 121.39
		Writ. Check	
			New Bal.

So what is your new balance? (Figure it out on PLATO. You need help if you make 2 mistakes in addition.)

Do not forget the decimal point. Please keep your answer in line with your other numbers.

Press <HELP> if you don't find your balance.

Objectives:

1. To enable the student to use his decimal skills to keep a balanced checkbook.
2. To provide a practical setting for the student to strengthen his skills at adding and subtracting decimals.

Description:

1. There are three sections:
 - a. How entries are made in a checkbook
 - b. Finding balance after deposits or checks
 - c. Making entries in your own checkbook
2. Checking account and money transactions are simulated for the students.

Grade Level: Basic mathematics

Student Time: 60 minutes

Subject Area: Arithmetic

ecs: 3567

File Name: per
Introduction to Percent

Author: Errol Magidson, Kennedy-King College

Objective:

To provide overall rationale, set of objectives, and index to lessons per1 and per2.

Description:

There are four sections:

- a. Rationale
- b. Lesson Objectives
- c. Definition of "percent"
- d. Index to Percent Lessons

Grade Level: Basic mathematics

Student Time: 10 minutes

Subject Area: Arithmetic

ecs: 1500

File Name: per1
Percent-Decimal-Fraction Conversions

Author: Errol Magidson, Kennedy-King College

Practice Exercise 2

Now you change each percent to a decimal:

PLATO's PERCENT: 80.1%

-HELP- available
for answer

Your DECIMAL: 0.801

That's it, Tamer.

Number in a row correct: 1 Number of mistakes: 1

Let's consider you an expert if you can get 4
in a row correct. You will be given review should
you miss 3.

Practice Exercise 3

Now you change each fraction to a percent:

PLATO's FRACTION: $3 \frac{1}{5}$

-HELP- available
for answer

Your PERCENT: 60%

PLATO applauds you, Tamer.

Number in a row correct: 1 Number of mistakes: 0

Let's consider you an expert if you can get 4
in a row correct. You will be given review should
you miss 3.

Objective:

To enable the student to convert from one to another among percents, decimals, and fractions.

Description:

1. There are three major sections:
 - a. Introduction
 - b. Converting from decimals to percents and vice versa
 - c. Converting from fractions to percents and vice versa
2. Each section has instruction and exercises.
3. The lesson has pre- and posttests.

Grade Level: Basic mathematics

Student Time: 60 minutes

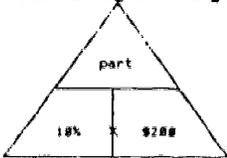
Subject Area: Arithmetic

ecs: 4146

File Name: per2 (jumps out to per3 and per4)
Word Problems with Percent

Author: Errol Magidson, Kennedy-King College

Wilbur's Magic Triangle



SOLUTION: part = 18% • \$200 (Now change 18% to a decimal;
part = .18 • \$200 then multiply.)
part = \$36

PROBLEM: How much is 18% of \$200?

Each number is placed in the appropriate section of the triangle.

The number we need to find is the . Press -NEXT-; then look at your triangle to see how PLATO solves the problem.

Practice Exercise 4

Solve these problems:

PROBLEM: Wilbur bargained with the salesman to pay 49% of his original offer. If Wilbur paid \$22.85, what was the salesman's original offer?

Identify the numbers given in your problem. If the number is not there, press the question mark (?).

percent	49%	
base	?	-HELP- available
part	> \$22.85	

Good answer, Wilbur.

Number in a row correct: 3 Number of mistakes: 0
Expert goal: 16 in a row Help: 4 mistakes

Objective:

To enable the student to solve word problems involving percent.

Description:

1. There are four sections:
 - a. Introduction to percent word problems.
 - b. Magic triangle method for solving word problems with percent.
 - c. More difficult word problems with percent.
 - d. Problems using simple interest.
2. Each section provides instruction and exercises.
3. The lesson has pre- and posttests.

Grade Level: Basic mathematics

Student Time: 90 minutes

Subject Area: Arithmetic

ecs: per2 4738
per3 1776
per4 4201

File Name: mars
Math Review Drills I

Authors: Shin Saito, City Colleges of Chicago, and
Noa Shinderman, Malcolm X College

0 problems done without help. 4 problems left.

Solve: $127.6 + 8.411 =$ \rightarrow

First line up the decimal points. To do so, move the lower number on the screen to the left or right by pressing the key "a" or "d".

Press "a" when the decimal points are lined up.

$$\begin{array}{r} 127.6 \\ + 8.411 \\ \hline \end{array}$$

0 problems done without help. 4 problems left.

Solve: $127.6 + 8.411 =$ \rightarrow

First line up the decimal points. To do so, move the lower number on the screen to the left or right by pressing the key "a" or "d".

Press "a" when the decimal points are lined up.

$$\begin{array}{r} 127.6 \\ + 8.411 \\ \hline \end{array}$$

Good, now type in the answer.

Objective:

To present review practice with help on fractions and decimals.

Description:

1. There are six sections:
 - Fractions
 - a. Multiplication
 - b. Division
 - Decimals
 - c. Addition (paper and pen needed)
 - d. Subtraction (paper and pen needed)
 - e. Multiplication (paper and pen needed)
 - f. Division (paper and pen needed)
2. In each section there is a short explanation of how to work the problem type indicated on the index. The section then consists of working exercises in that problem type. Help is available to show the student how to work on exercises. He must, however, do four exercises without help to complete the section.

Grade Level: Basic mathematics

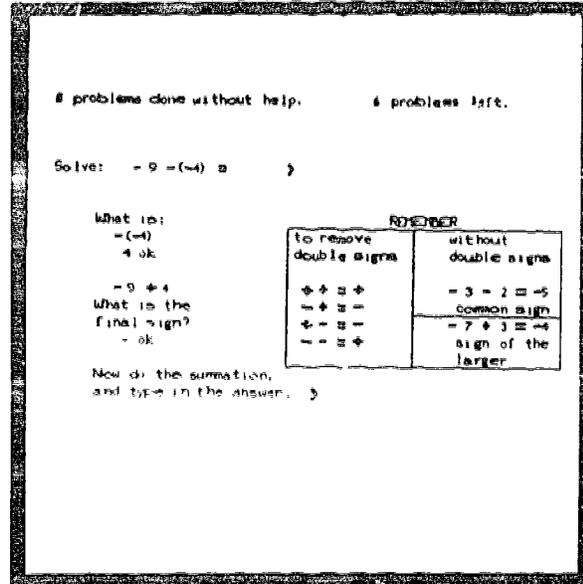
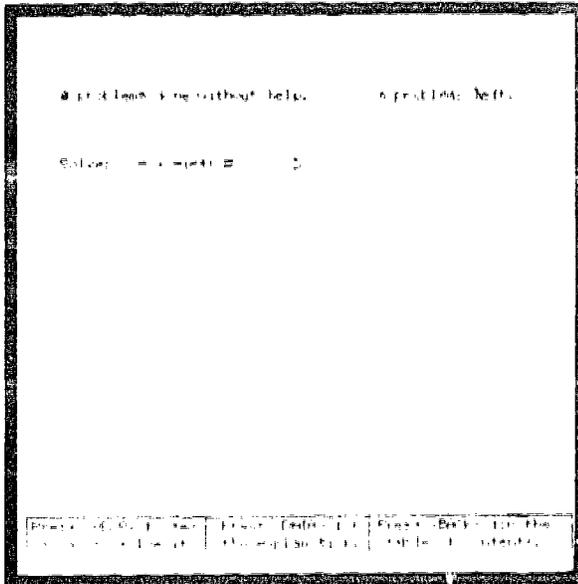
Student Time: 35 minutes

Subject Area: Arithmetic

ecs: 2788

File Name: mars4
Math Review Drills II

Authors: Shin Saito, City Colleges of Chicago, and
Noa Shinderman, Malcolm X College



Objective:

To present review practice with help on signed numbers and powers of ten.

Description:

- There are five sections:
 - Signed Numbers
 - Addition and Subtraction
 - Double Signs
 - Multiplication
 - More Addition and Subtraction
 - The Powers of Ten
 - Multiplication and Division
- In each section there is a short explanation of how to work the problem type indicated on the index. The rest of the section consists of working exercises of that problem type. Help is available to see how to work a given exercise. The student must, however, do six exercises without help to complete the section.

Grade Level: Basic mathematics

Student Time: 35 minutes

Subject Area: Arithmetic

ecs: 2451

File Name: sqrt
Finding the Square Root

Author: Tamar Abeliovich Weaver, CERL

OLD MESSY RESULTS OF SQUARE ROOTS

1.000	6.965	48.00
1.000	6.448	41.25

Try to guess the square root of 41.00

Let the square root answer be within 0.05 of 41.00

Try a better guess: 6.45

The square of your guess is 41.60

We can divide by our guess:

$$41.00 \div 6.45 = 6.356$$

The root is between the GUESS and the RESULT.

Great! Let's try 6.35

$\sqrt{530} = ?$

First we can draw a smaller square that has a side of 20.

This gives an area of 400. It is smaller than the original square but

$$\begin{array}{r} 530 \\ - 400 \\ \hline 130 \end{array}$$

and that missing area makes up the two rectangles and the small square.

Objective:

- To provide three methods for finding square roots:
- Guessing and Adjusting
 - Newton's Method
 - The Square Root Algorithm

Description:

The student gets an index from which he can choose one method and/or see an explanation of why the method works. Each technique is taught by helping the student through the steps.

Grade Level: Basic mathematics

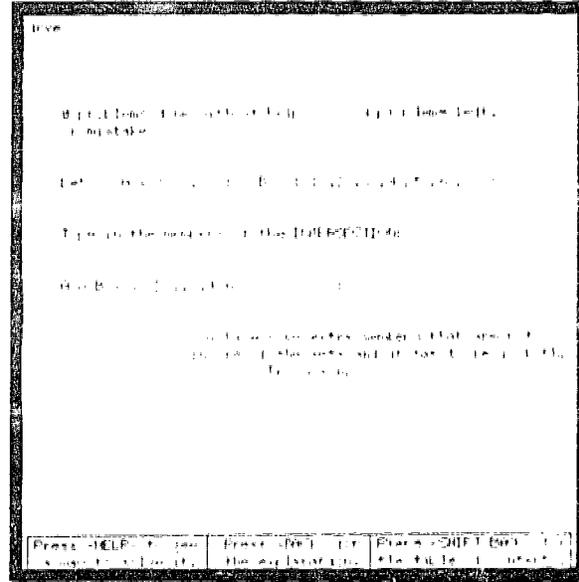
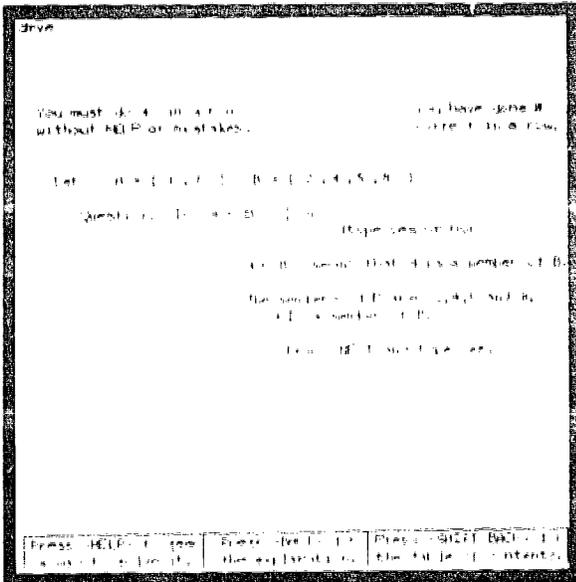
Student Time: 30 minutes

Subject Area: Arithmetic

ecs: 3470

File Name: ccset
Introduction to Sets

Authors: Tamar Abeliovich Weaver and Louis V. DiBello, CERL
programmed by Tamar Abeliovich Weaver, CERL



Objective:

To provide an introduction to set theory including a discussion of sets, subsets, elements of a set, and the three operations: union, intersection, and complementation.

Description:

1. Each topic is presented via a short description and example.
2. Practice exercises are given which include help and error feedback.
3. The student must correctly complete four exercises in a row for each topic.

Grade Level: Intermediate algebra

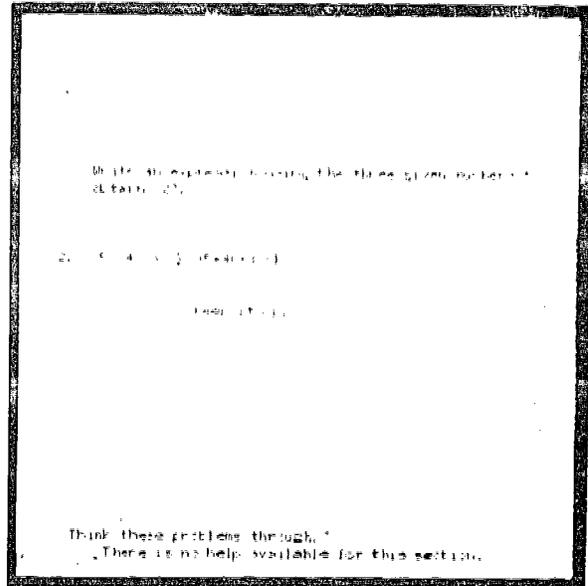
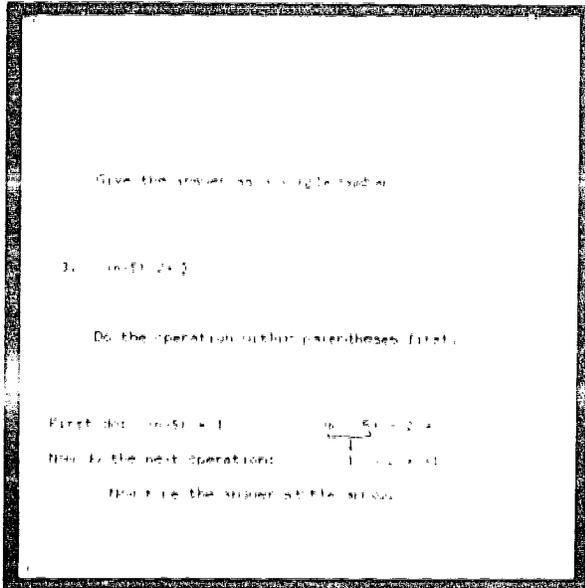
Student Time: 20 minutes

Subject Area: Algebra

ecs: 2524

File Name: math95c
Symbols of Grouping

Authors: Mitsuru Yamada, Malcolm X College, Steven Brayndick,
Malcolm X College, and Shin Saito, City Colleges of
Chicago



Objective:

To present easy numerical problems involving order of operations and parentheses.

Description:

1. There are five sections:
 - a. Addition and subtraction without parentheses
 - b. Addition and subtraction with parentheses
 - c. Operations without parentheses
 - d. Operations with parentheses
 - e. Backward drill
2. In each section the student is asked to evaluate arithmetic expressions. Some sections contain expressions with parentheses, while others do not. The student may press DATA to be given a sequence of questions and arrows which lead him through the evaluation in steps; or he may press HELP to be shown how to perform the evaluation. He must perform ten evaluations without HELP to complete a section.

Grade Level: Basic mathematics

Student Time: 30 minutes

Subject Area: Arithmetic

ecs: 2941

File Name: mars1
Word Problems Drills I

Author: Shin Saito, City Colleges of Chicago

Press -HELP- if you want the answer.
Press -DATA- for some hints toward solving.

Type the appropriate answer or expression.

1. If Joe walks three miles per hour, how many miles will he walk in two hours?

3-2-04

Good

Press -HELP- if you want the answer.
Press -DATA- for some hints toward solving.

Type the appropriate answer or expression.

2. If Jim drives thirty miles per hour, how many miles will he drive in 10 hours?

3-2-04

Good

If Jim travels 30 miles each hour, just multiply to find out how far he travels in 10 hours.

Objective:

To enable the student to translate simple word problems into algebraic and arithmetic expressions.

Description:

There are two sections:

- a. Beginning Exercises I
- b. Rate Problems II

Each section consists of ten word problems. At the beginning, the problems are arithmetic. At the end it is necessary to solve a linear equation to solve the problem. The student can obtain the correct answer by pressing HELP. However, he must solve all problems without help to complete the section.

Grade Level: Elementary Algebra

Student Time: 15 minutes

Subject Area: Algebra

ecs: 3164

File Name: dist
The Distributive Law

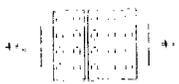
Author: Tamar Abeliovich Weaver, CERL
programmed by Robert Baillie, CERL

Preview
Examples:



$$3 \times 4 = 12$$

What will be the equivalent of $4 \times (2 + 3)$ if we have 12 dots? $4 \times (2 + 3) = 20$



$$4 \times (2 + 3) = 20$$

rep533: dist

We look at $3 \times (2 + 3)$ as addition of

$$\begin{array}{r} -5 \\ +5 \\ \hline 0 \\ +2 \\ \hline 2 \end{array}$$

So $3 \times (2 + 3)$ is the addition of

$$\begin{array}{r} -5 + 2 \\ +5 + 2 \\ +5 + 2 \\ \hline 3 \times (2 + 3) = 15 \end{array}$$

We can add the columns separately

$$\begin{array}{r} -5 + 2 \\ +5 + 2 \\ +5 + 2 \\ \hline 3 \times (2 + 3) = 15 \end{array}$$

We added the same numbers, so the two ways are equal:

$$3 \times (2 + 3) = 20 = 3 \times 2 + 3 \times 3$$

Objectives:

1. To provide a graphic model for the distributive law.
2. To provide practice on the distributive law with signed numbers and variables.

Description:

1. A model of dots in rows and columns is used to get the rule $a \times (b + c) = a \times b + a \times c$.
2. The student assigns signed numbers to a , b , and c and applies this rule.
3. A simple example of repeated addition is provided as an alternative justification of the rule.
4. The student is given practice exercises in applying the law with signed numbers and variables.

Grade Level: Elementary Algebra

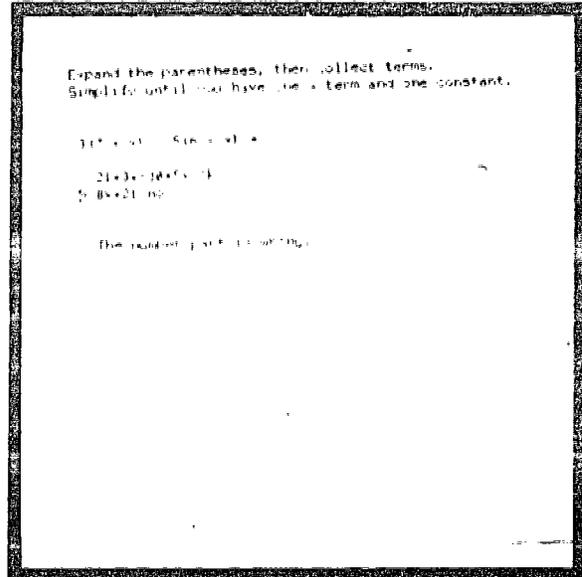
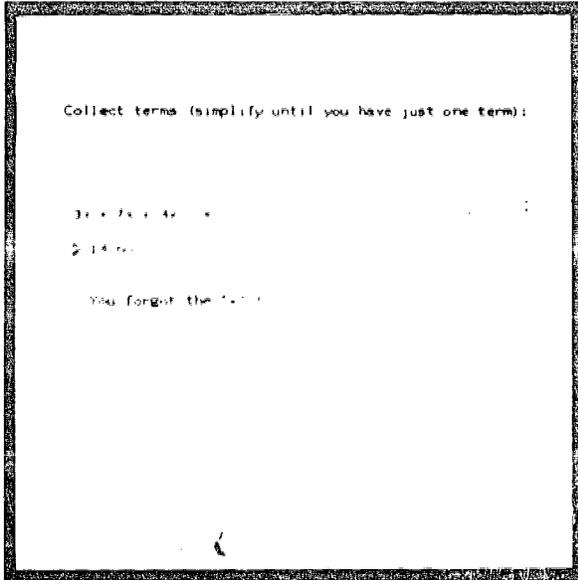
Student Time: 30 minutes

Subject Area: Algebra

ecs: 4831

File Name: collect
Collecting Like Terms

Author: Tamar Abeliovich Weaver, CERL
programmed by Robert Baillie, CERL



Objectives:

1. To introduce the following terminology: like terms, x-term, constant.
2. To provide practice in simplifying algebraic expressions by collecting like terms.

Description:

After introducing the vocabulary, the student answers simple questions on identifying x-terms and constants. The distributive law is used to open parentheses and like terms are collected to simplify the results.

Grade Level: Elementary algebra

Student Time: 25 minutes

Subject Area: Algebra

ecs: 3790

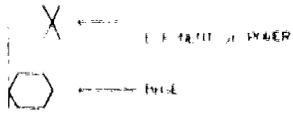
Special Notes:

The distributive law is a prerequisite (available in lesson "dist").

File Name: exp3
Introduction to Exponents

Author: Carroll (Steve) Robinson, Chicago Urban Skills
Institute

EXPONENTS WRITTEN



Exponential Notation, or exponent as it is commonly called, is composed of 2 parts -- BASE and EXPONENT.

BASE: the number multiplied by itself many times.

EXPONENT: tells how many times the base is to be multiplied in an multiplication form.

EXAMPLE: $6^4 = 6 \cdot 6 \cdot 6 \cdot 6$

In the above example, the base is 6 and 6 is multiplied with itself 4 times. The exponent is 4, which is the base.

EXPONENTS WRITTEN EXPONENTIAL NOTATION

Convert the following multiplication notation into exponential notation.

Enter the answer with a **SHIFT-BOOK** or help:

$19 \cdot 19 \cdot 19 \cdot 19 \cdot 19 = 19^5$

$12 \cdot 12 = 12^9$

$18 \cdot 18 \cdot 18 \cdot 18 \cdot 18 \cdot 18 \cdot 18 = 18^7$

$14 \cdot 14 \cdot 14 \cdot 14 \cdot 14 \cdot 14 \cdot 14 = 14^7$

GIVEN: $14 \cdot 14 \cdot 14 \cdot 14 \cdot 14 \cdot 14 \cdot 14$

First number is written down many times $\Rightarrow 14 \cdot 14 \cdot 14 \cdot 14 \cdot 14 \cdot 14 \cdot 14$ is the base.
How many times is 14 written down? $\Rightarrow 7$
Result is 7 is the exponent or power.
Now return to the problem and give the answer.

Congratulations... **SHIFT-BOOK**
NEXT for another problem
SHIFT-BOOK for index

SHIFT-HELP to stop the
SHIFT-BOOK to stop the

Objective:

To provide an introduction and drill and practice on exponents.

Description:

There are six sections:

- What Is an Exponent
- Practice Writing Exponential Notation
- Practice Writing Multiplication Notation
- Calculating Numerical Value
- Practice Calculating Numerical Value
- Final Quiz

Grade Level: High School and above

Student Time: 50 - 60 minutes

Subject Area: Algebra

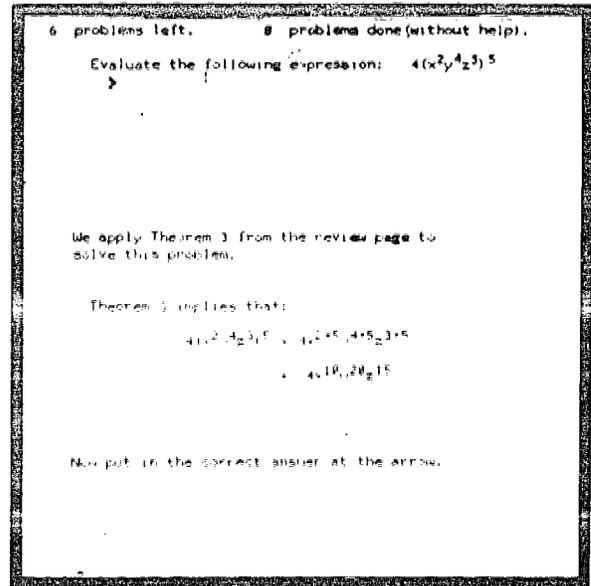
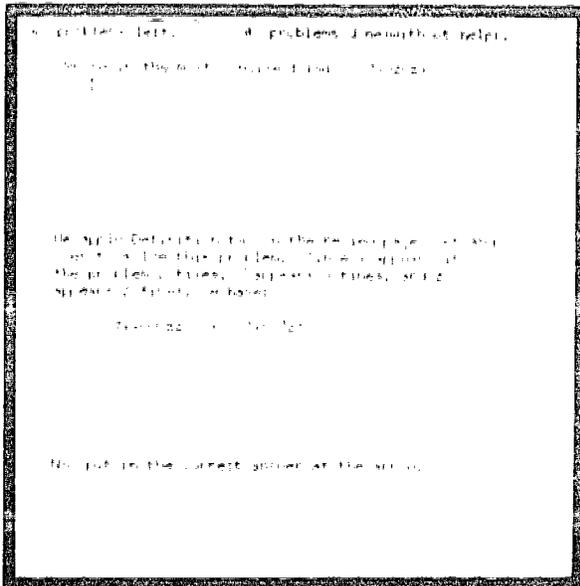
ecs: 4140

Special Notes:

- A section covering the SUPER key precedes the index.
- A student is only required to pass the final quiz to complete the lesson.

File Name: math95b
Laws of Exponents

Author: Richard Neapolitan, Wright College



Objective:

To present practice with help on exponent problems.

Description:

1. There are seven sections:
 - a. Writing an expression in exponential form
 - b. Writing an expression without exponents
 - c. Multiplying exponential expressions in one variable
 - d. Multiplying exponential expressions in three variables
 - e. Dividing exponential expressions
 - f. Expressions (one variable) to a power
 - g. Expressions (multiple variables) to a power
2. In each section the student is first shown how to perform the task indicated on the index page. He must then successfully perform that task six times to complete the section. He may, however, request HELP at any time to receive assistance on a given problem. The HELP consists of being shown how to perform the task in steps.

Grade Level: Intermediate algebra

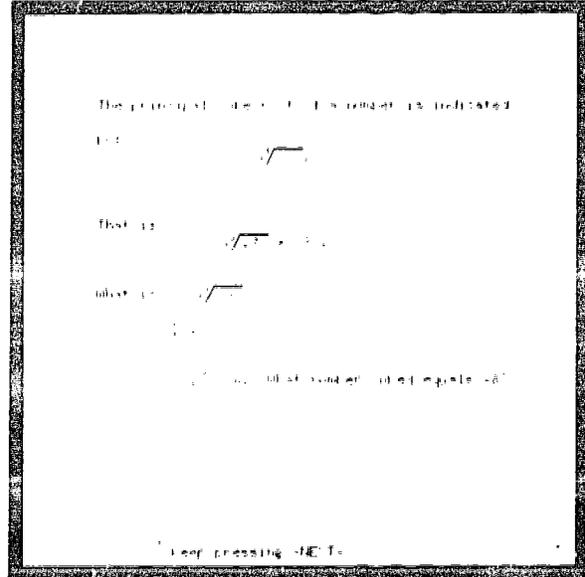
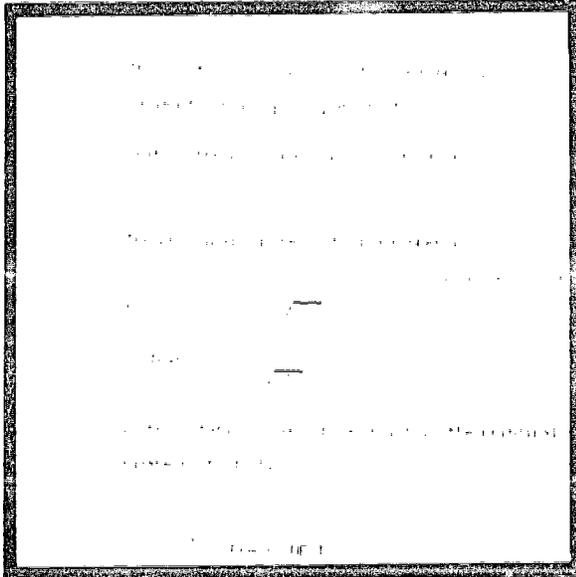
Student Time: 40 minutes

Subject Area: Algebra

ecs: 2207

File Name: math95f
Powers and Roots of Natural Numbers

Authors: Shin Saito, City Colleges of Chicago, and
Richard Neapolitan, Wright College



Objective:

To present practice with help on roots of natural numbers.

Description:

1. There are five sections:
 - a. Powers
 - b. Introduction to Radicals
 - c. Radicands
 - d. The Principal Square Root
 - e. The Principal Cube Root
2. Section a teaches the student the concept of a power. The student must find four powers without HELP to complete the section. He may, however, request HELP to find a given power. The HELP consists of a sequence of questions and arrows which lead him through the steps involved.
3. Section b introduces him to the concept of roots and radicals.
4. Sections c, d, and e test him on the concepts indicated on the index. The format and requirements to complete these sections are exactly those of section a.

Grade Level: Intermediate algebra

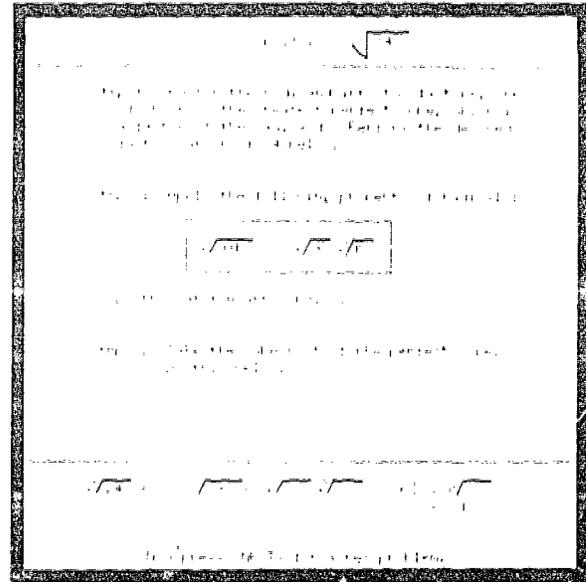
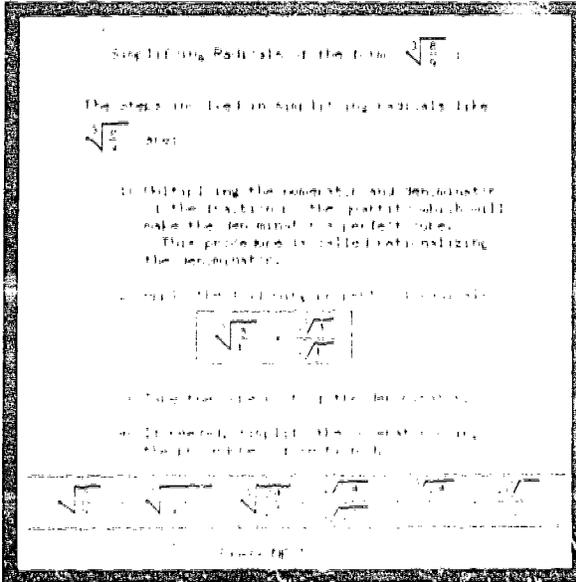
Student Time: 30 minutes

Subject Area: Algebra

ecs: 2339

File Name: frac
Introduction to Radicals I

Authors: Shin Saito, City Colleges of Chicago, and Richard
Neapolitan, Wright Colleges



Objective:

To provide an introduction and practice on radicals.

Description:

1. There are five sections:
 - a. Properties of Radicals
 - b. Simplifying a Square Root
 - c. Simplifying a Square Root with a Fraction
 - d. Simplifying a Cube Root
 - e. Simplifying a cube root with a Fraction
2. Section a contains the statement of four properties of radicals used in the following four sections.
3. In each of the last four sections the student is first shown how to simplify the radical type indicated on the index. The student must then simplify radicals of that type himself. The student may press HELP to receive a series of questions which will lead to the simplification of a radical. He must, however, simplify four radicals without HELP to complete the lesson.

Grade Level: Intermediate algebra

Student Time: 30 minutes

Subject Area: Algebra

ecs: 4673

File Name: math95d
Addition of Radicals

Authors: Shin Saito, City Colleges of Chicago and
Richard Neapolitan, Wright College

Problems left: 4. Problems done (without help): 0.

Find the sum: $3\sqrt{6} + 2\sqrt{6}$

* $18\sqrt{6}$
Excellent

Perform the addition on PAPER.
Then enter the result above.

By pressing:
HELP- will give you aid in solving the problem.
LAD- will explain how to work the arrow (t).
DATA- lets you review the introduction to this section.
BACK- allows you to go back to the table.

Find the sum: $9\sqrt{45} + 6\sqrt{80}$

HELP IS AVAILABLE

$$9\sqrt{45} + 6\sqrt{80} = 9(3\sqrt{5}) + 6(4\sqrt{5})$$

$$= 27\sqrt{5} + 24\sqrt{5}$$

$$= 51\sqrt{5}$$

Step 1: Simplify both radicals.
Do this at the arrows above.

Step 2: Add the similar radicals.

You have completed this problem.
Now press -NEXT- for a new problem.

Objective:

To present practice with help on addition of radicals.

Description:

1. There are four sections:
 - a. Addition of Radicals
 - b. Adding Similar Radicals
 - c. Adding Two Radicals
 - d. Adding Several Radicals
2. In section a the student is shown how to add similar radicals, and shown how to combine radicals which can be simplified into similar radicals.
3. In section b, he must add similar radicals. He must do four problems without HELP to complete the section. He may, however, request HELP at any time, to work a given problem. The HELP consists of a sequence of questions and arrows which lead him through the problem in steps.
4. In sections c and d he must add radicals which are not similar. The criteria and HELP are similar to that of section b.

Grade Level: Intermediate algebra

Student Time: 30 minutes

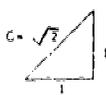
Subject Area: Algebra

ecs: 3478

File Name: math951
Irrational Numbers

Authors: Allan Meers, Wright College, Shin Saito, City
Colleges of Chicago, and Richard Neapolitan,
Wright College

Next we'll draw a right triangle whose two adjacent sides both have length equal to 1.



According to the Pythagorean Theorem, what is the value of $C^2 = 2$?

Since $C^2 = 2$, $C = \sqrt{2}$.

So we see $\sqrt{2}$ is an actual length, namely a length of one side of the triangle above.

PRESS NEXT

2 problems left. 2 problems done (without help).

Is $\sqrt{4}$ rational?

Yes

We apply the following rule:

If an integer is not the square of another integer, then its square root is irrational.

Is 4 the square of an integer? Yes

That was correct, now considering the rule above, is the square root of 4 rational?

Yes

Press NEXT for a new problem

Objectives:

1. To present a rationale for the existence of irrational numbers.
2. To present practice in recognizing irrational roots of whole numbers.

Description:

1. There are two sections:
 - a. Introduction
 - b. Drill
2. Section a demonstrates how the need for more numbers gave rise to the rational numbers; then further need gave rise to the irrationals.
3. Section b is a drill designed to teach the student which roots of whole numbers are irrational. He must recognize four numbers correctly to complete the lesson.

Grade Level: High School and above

Student Time: 20 minutes

Subject Area: Algebra

ecs: 2595

File Name: algex
Introduction to Polynomials

Author: B. F. Lathan, Kennedy-King College

Objective:

To provide an introduction and practice exercises on operations with monomials.

Description:

1. Operation with monomials.
2. Definitions of monomial, binomial, trinomial, and polynomial are introduced.
3. This introduction is followed by four drill sections on:
 - a. Adding monomials
 - b. Combining like terms
 - c. Multiplying monomials
 - d. Dividing monomials
4. The criterion for each section is to do five problems correctly (not necessarily in a row).
5. A short review can be accessed in each section by using the BACK key.
6. A lesson (file name: puzz) containing a crossword puzzle on algebraic vocabulary can be accessed from the index of this lesson.

Grade Level: Elementary algebra

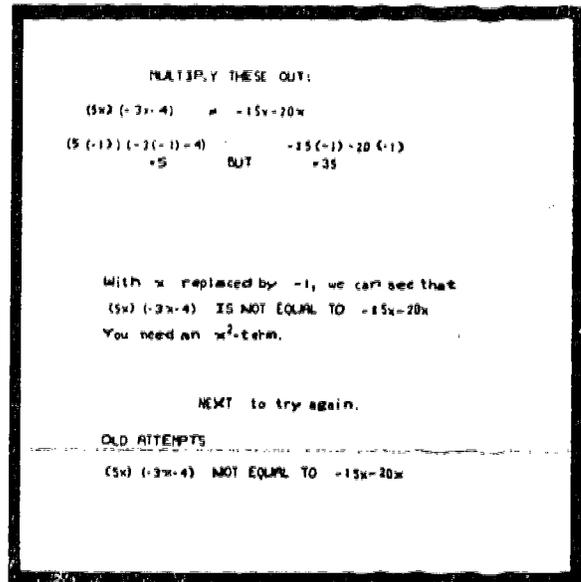
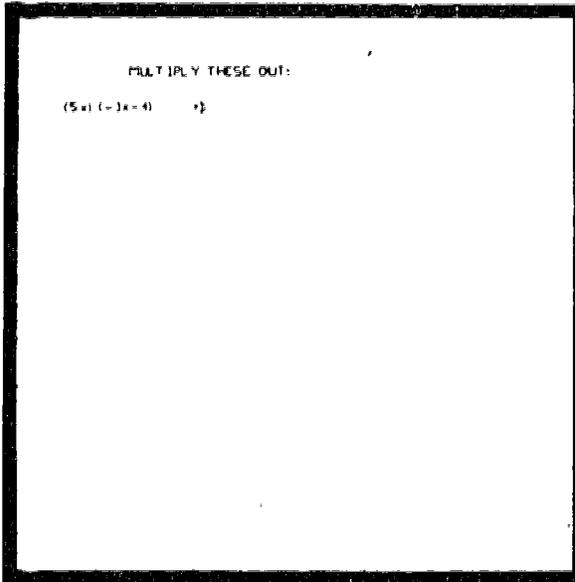
Student Time: 40 minutes

Subject Area: Algebra

ecs: 4331

File Name: quad1
Binomial Products: $(x + 2)(x - 3)$ etc.

Author: Louis V. DiBello, CERL



Objective:

To provide drill practice in multiplying binomials

Description:

1. There are four sections:
 - a. A guide to these drills
 - b. Products like $3x(-2x + 5)$
 - c. Products like $(x - 2)(x + 3)$
 - d. Products like $(-5x + 1)(2x - 4)$
2. In each of the drill sections the problems are generated at random, and the student may work as many problems as he wants.
3. Unacceptable answers are diagnosed and saved on the screen for the student; the correct answer is given after four mistakes.

Grade Level: Elementary Algebra

Student Time: 45 minutes

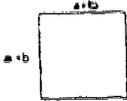
Subject Area: Algebra

ecs: 3382

File Name: park2
Binomial Products: $(a + b)(a - b)$ etc.

Authors: Paul Thompson, Parkland College, and Robert Baillie,
CERL

Here is a square.
Each side is $(a+b)$.



The area of this square is $(a+b) \times (a+b)$ or $(a+b)^2$.

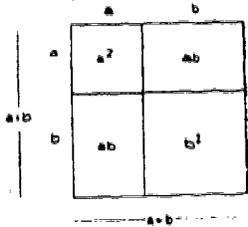
Sometimes we want to multiply this out:

$$(a+b)^2 = a^2 + 2ab + b^2$$

Press NEXT to see WHY $(a+b)^2$ equals $a^2 + 2ab + b^2$

Here is a square with sides $(a+b)$ and $(a+b)$
What is its area? $(a+b)^2$ ok

Each side is the SUM of the lengths a and b .
Now let's divide the large square into four smaller pieces.
The area of the LARGE square is the SUM of the areas of
the four SMALLER pieces!



The area of the large square is $(a+b)^2$.
What is ANOTHER expression for $(a+b)^2$?

$$a^2 + 2ab + b^2 \text{ ok}$$

Therefore,

$$(a+b)^2 = a^2 + 2ab + b^2$$

AREAS:
 a^2
 b^2
 ab
 ab

Objective:

To provide instruction and practice in binomial products.

Description:

- There are five sections:
 - $(a + b)^2$
 - $(a - b)^2$
 - $(a + b)(a - b)$
 - $(a + b)(c + d)$
 - Review Questions
- In each of the first four sections, a geometric diagram is used to justify the appropriate algebraic formula (e.g., $(a + b)^2 = a^2 + 2ab + b^2$ in section one). Then the student is given exercises of the same type until he has answered four in a row on first or second try. Section five contains exercises of all four types.

Grade Level: Elementary algebra

Student Time: 60 minutes

Subject Area: Algebra

ecs: 4182

File Name: math95e
Math Special Products I

Authors: Shin Saito, City Colleges of Chicago, and
Richard Neapolitan, Wright College

Problems left: 4. Problems done (without help): 0.

What is the product of the binomials.
 $(2x+5y)(2x-5y)$?

Apply the rule:

$$(ax + by)(ax - by) = a^2x^2 - b^2y^2$$

According to the above rule, write the coefficient of x^2 below.

$$(2x + 5y)(2x - 5y) = ? x^2 - \quad y^2$$

-HELP AVAILABLE-

Problems left: 4. Problems done (without help): 0.

What is the product of the binomials.
 $(2x+5y)(2x-5y)$?

Apply the rule:

$$(ax + by)(ax - by) = a^2x^2 - b^2y^2$$

According to the above rule, write the coefficient of y^2 below.

$$(2x + 5y)(2x - 5y) = 4x^2 - 25y^2$$

All that is left to do is to return to the original arrow and write the answer.

-HELP AVAILABLE-

Objective:

To provide practice with help in special products.

Description:

1. There are three sections:
 - a. Problem type: $(ax + by)(ax - by)$
 - b. Squaring a binomial
 - c. Multiplying two binomials
2. In each section the student is shown how to find the type of product indicated on the index page. He must then find six products of that type without HELP to complete the section. The HELP consists of a sequence of questions which lead him to finding the product in steps.

Grade Level: Intermediate algebra

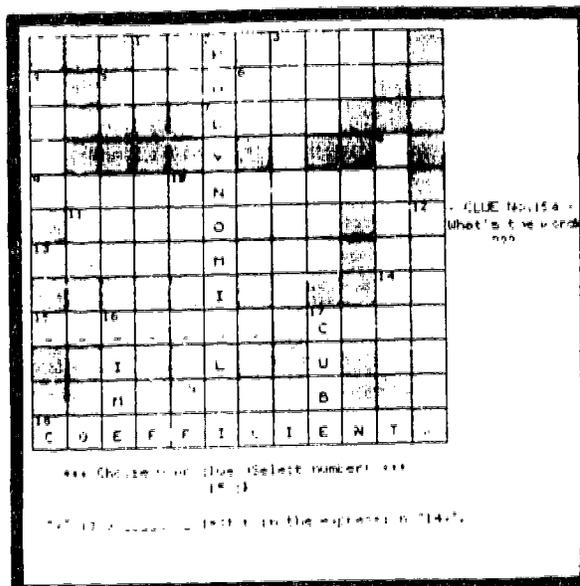
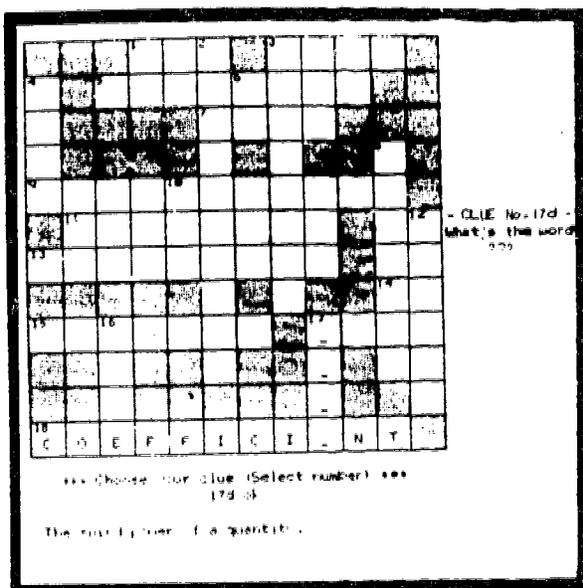
Student Time: 25 minutes

Subject Area: Algebra

ecs: 3478

File Name: puzzl
Crossword Puzzle on Algebraic Vocabulary

Author: B. F. Lathan, Kennedy-King College



Objective:

To provide practice working with terminology of polynomials.

Description:

1. The crossword puzzle to be completed is displayed on the screen. The student chooses a location (e.g., 3a for 3 across). He is then given the clue for that word and can enter his answer in the puzzle.
2. The student can erase previous answers and by using the HELP key, he can get the correct answer for a location he selects.
3. Complete instructions can always be accessed by using the BACK key.
4. When the student has filled in the puzzle, he can have his answers checked. He is required to correct any mistakes.

Grade Level: Intermediate algebra

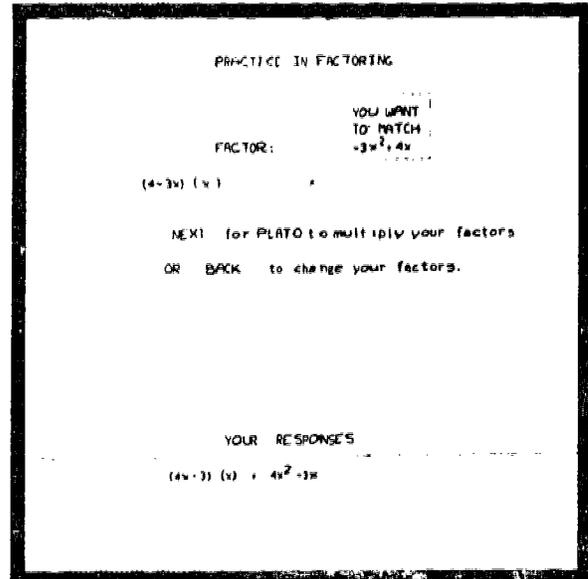
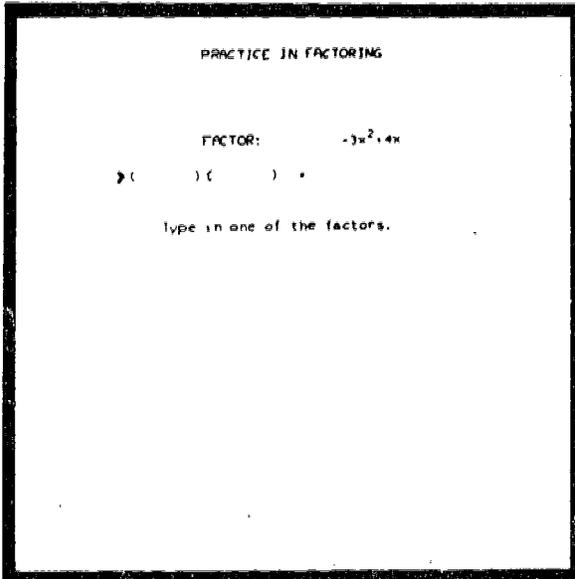
Student Time: 20 minutes

Subject Area: Algebra

ecs: 2631

File Name: quad2
Factoring Quadratic Polynomials

Author: Louis V. DiBello, CERL



Objective:

To provide drill practice in factoring quadratic polynomials.

Description:

1. There are five sections:
 - a. A guide to these drills
 - b. Polynomials like $3x^2 - 5x$
 - c. Polynomials like $x^2 - x + 2$
 - d. Polynomials like $-2x^2 + 5x + 3$
 - e. Polynomials like $10x^2 - 31x - 63$
2. In each of the drill sections the problems are generated at random, and the student can work as many problems as he wants.
3. The student is required to factor each quadratic into a product of two linear factors by providing the linear factors one at a time. Once the student has given two linear factors, his two factors are multiplied out by PLATO to show him whether his factorization is correct or not. Incorrect factorizations are saved on the screen and diagnosed for the student.

Grade Level: Intermediate algebra

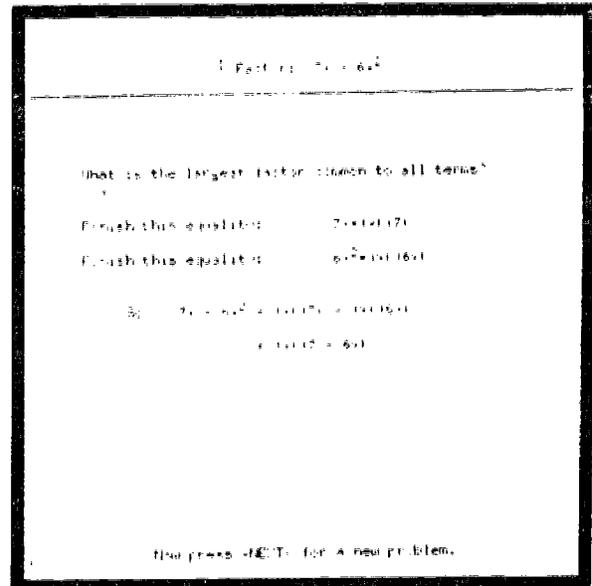
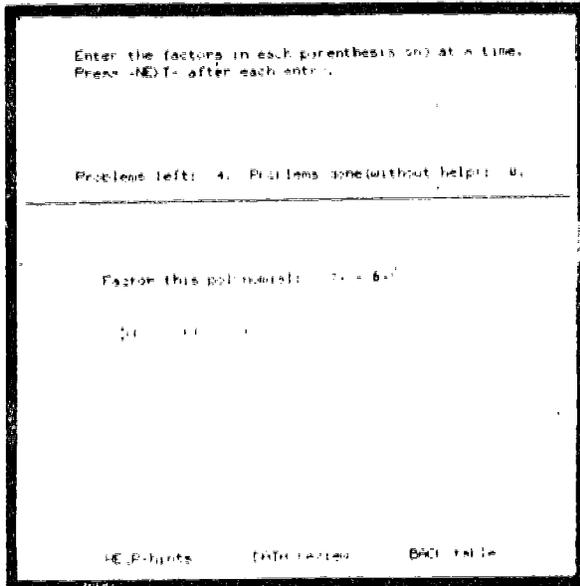
Student Time: 60 minutes

Subject Area: Algebra

ecs: 2495

File Name: math95a
Factoring Polynomials

Authors: Shin Saito, City Colleges of Chicago, and
Richard Neapolitan, Wright College



Objective:

To present practice with help on factoring polynomials.

Description:

1. There are six sections:
 - a. Problem type: $ax - bx^2$
 - b. Problem type: $ax^4 + bx^2 + cx$
 - c. Problem type: $ax^2y + bxy + cxy^2$
 - d. Factoring the difference of two squares
 - e. Factoring the trinomial square
 - f. Factoring the trinomial
2. In each section the student is first shown how to factor the polynomial type listed for that section. He must then factor four polynomials of that type without HELP to complete the section. He may, however, request HELP at any time to receive assistance in factoring a given polynomial. The HELP consists of a sequence of questions and arrows which lead the student through the factoring process in steps.

Grade Level: Intermediate algebra

Student Time: 40 minutes

Subject Area: Algebra

ecs: 4715

File Name: solve1
Solving Linear Equations

Author: Mitsuru Yamada, Malcolm X College

In order to get credit for doing this kind of equation, you must complete one problem without help (choice '4' below). To finish the lesson, you must get credit for each kind of equation shown on the previous page (except the optional section).

problem

$$-32x - 22 = +3$$

How much help do you want for the problem above. Type a number. It is advisable to start with '1.'

1. PLATO will tell you what to do. PLATO will also do the computations for you.
2. You tell PLATO what to do. PLATO will do the computations for you.
3. You type out the next step of the equation but PLATO will tell you what to do.
4. You type out the next step of the equation. PLATO will help when you ask.

problem

$$-32x - 22 = +3$$

step 1

$$-32x = +25$$

step 2

$$\frac{-32x}{-32} = \frac{25}{-32}$$

There is a fraction on the left which can be reduced. Type 'r1' and press NEXT. PLATO will reduce all fractions on the left.

DATA for information: -- BACK to go back.
Press SHIFT-DATA to start this problem over again.

Objective:

The student will solve one equation of each type (see the following description) without help from PLATO.

Description:

1. One-step problems like $3x = 4$.
2. Two-step problems like $2x + 3 = 4$.
3. Equations where 'x' appears on both sides of the equal sign.
4. Equations which have terms that can be combined.
5. Equations with parentheses.
6. Equations with fractions.
7. Harder equations with fractions (optional)

Grade Level: Intermediate algebra

Student Time: 2 - 3 hours estimated

Subject Area: Algebra

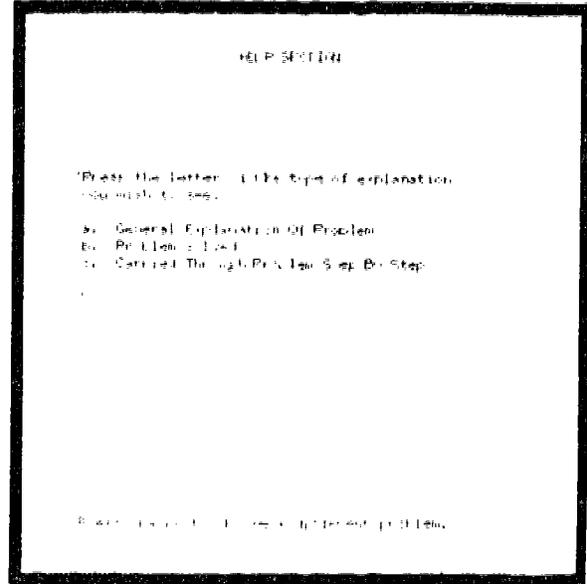
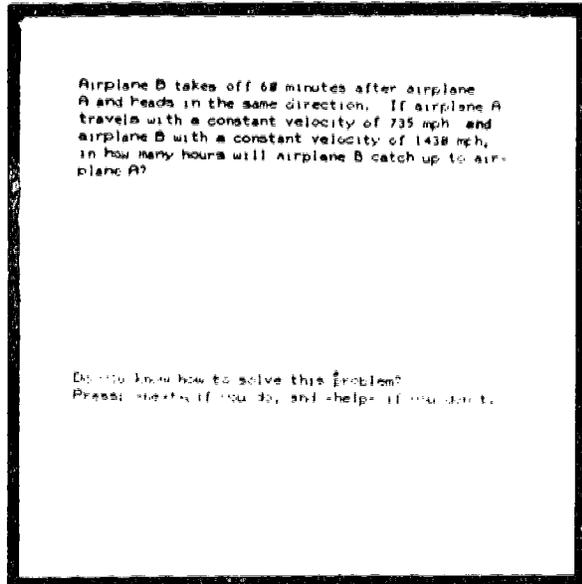
ecs: 7479

Special Notes:

1. There are four levels of "help" available to the student on each problem. At the highest level, PLATO tells the student what to do next and then does the arithmetic for the student. At the lowest level, the student must type in an equivalent equation.
2. There is cumulative data available to all non-student users of this lesson.

File Name: word1
Word Problems Involving Linear Equations

Authors: Gary Peltz, Malcolm X College, and Mitsuru Yamada,
Malcolm X College



Objective:

The student will be able to write equations for the word problems presented in this lesson and solve the equations.

Description:

Problems involving age, mixture, and rates are presented.

Grade Level: Intermediate algebra

Student Time: 60 minutes

Subject Area: Algebra

ecs: 4548

File Name: math95g
Reducing Algebraic Fractions

Author: Richard Neapolitan, Wright College

You've completed 0 problems without help. The requirement is 2.

Reduce the following fraction to lowest terms:
What is the new numerator?

$$\frac{20x^6y^2}{12x^2y^4}$$

First you must divide the numerator and the denominator by the highest power of x which divides both numerator and denominator. What is it?

2 (x)

Remember, when you divide you subtract exponents. We must also divide the numerator and denominator by the greatest common divisor of 20 and 12. What is it?

4 (y)

Finally, divide numerator and denominator by the highest power of y which divides both numerator and denominator. What is it?

2 (y)

Now go back to the original arrow and give the correct answer to the problem.

You've completed 0 problems without help. The requirement is 2.

Reduce the following fraction to lowest terms:
What is the new numerator?

$$\frac{x^2+18x+24}{x^2+7x+12}$$

If the numerator and the denominator can both be factored and if they both contain the same factor, then we reduce the expression by dividing the numerator and the denominator by this factor.

Write the numerator in factored form:
(x+6)(x+4) (x)

Write the denominator in factored form:
 (x+4)(x+3) (x)

Press HELP again if you do not know the answer to one of these new questions.

Objective:

To present introduction and practice with help on reducing algebraic fractions.

Description:

- There are four sections:
 - Problems of the form $8x^4/4x^2$
 - Problems of the form $10x^6y^4/2x^4y^7$
 - Problems of the form $(6x^5 - 4x^4)/12x^2$
 - Problems of the form $(x^2 + 5x + 6)/(x^2 + 3x + 2)$
- In each section the student is shown how to reduce the fraction shown on the index. He must then reduce two fractions without HELP to complete the section. He may, however, request HELP for any given fraction to receive a sequence of questions and arrows which will lead him through the reduction process in steps.

Grade Level: Intermediate algebra

Student Time: 35 minutes

Subject Area: Algebra

ecs: 3471

File Name: math95h
 Multiplying Algebraic Fractions

Author: Richard Neapolitan, Wright College

You've completed 8 problems without help. The requirement is 2.

Perform the indicated multiplication: (Give FINAL answer)

What is the new numerator?

$$\frac{x^2 + 8x + 16}{y^8} \cdot \frac{y^3}{x+4}$$

You should need PENCIL and PAPER.

Press

HELP to receive help in solving this problem.
 DITH for the theory on solving this problem.
 BAKY to return to the table of contents.

You've completed 8 problems without help. The requirement is 2.

Perform the indicated multiplication: (Give FINAL answer)

What is the new numerator?

$$\frac{x^2 + 8x + 16}{y^8} \cdot \frac{y^3}{x+4}$$

We can factor the quadratic term appearing in the numerator so that our product looks as follows:

$$\frac{(x+4)(x+4)}{y^8} \cdot \frac{y^3}{x+4}$$

What power of y appears in both numerator and denominator?

Press HELP again if you do not know the answer to one of these new questions.

Objective:

To present practice with help on multiplication of algebraic fractions.

Description:

1. There are three sections:
 - a. Problems of the form $(x^5/3y^2) \times (7x^3/y^4)$
 - b. Problems of the form $(x^4/3y^5) \times (5y^2/x^3)$
 - c. Problems of the form $[(x^2 + 7x + 12)/y^7] \times [y^6/(x + 4)]$
2. In each section the student is first shown how to multiply the algebraic fractions shown on the index. He must then perform two multiplications without HELP to complete the section. He may, however, request HELP for any problem to receive a series of questions and arrows which will perform the multiplication for him.

Grade Level: Intermediate algebra

Student Time: 35 minutes

Subject Area: Algebra

ecs: 3101

File Name: math95i
Finding the Least Common Multiple of Algebraic Expressions

Author: Richard Neapolitan, Wright College

Press HELP to be given the answer to a question.

Find the least common multiple (L.C.M.) of these expressions:
 $27x^3y^2$ and $21x^2y^3$.

1. Factor each expression into prime factors.

Factored
first expression: $3^3 \cdot 3 \cdot y^2$

Factored
second expression: $7 \cdot 3 \cdot 3 \cdot y^3$

2. The L.C.M. is the product of the different prime factors, each raised to the HIGHEST exponent that occurs.

What is the highest exponent of x ?

Press 899 for table of contents.

Press HELP to be given the answer to a question.

Find the least common multiple (L.C.M.) of these expressions:
 $2x^2 + 25$, $x^2 - 49$, and $4x$.

1. Factor each expression into prime factors.

Factored
first expression: $(x+5)(x-5)$

Factored
second expression: $(x-7)(x+7)$

The third expression is simply a linear expression. Therefore, it is prime and is already factored.

Factored
third expression: $4x$

In this problem, each prime factor appears only to the first power. The L.C.M. is simply the product of these prime factors. Type the L.C.M.

Press 899 for table of contents.

Objective:

To present practice with help on finding the least common multiple of algebraic expressions.

Description:

1. There are five sections:
 - a. Two expressions of the form $6x^3y^4$
 - b. Three expressions of the form $6x^3y^4$
 - c. Three expressions of the form $x^2 + x - 6$
 - d. Two expressions of the form $x^3 + x^2 - 6x$
 - e. Three expressions of the form $x^2 + x - 6$
2. In each section the student is first shown how to find the least common multiple of expressions of the form indicated by the index. He must then find the least common multiple in three problems without HELP to complete the section. He may, however, request HELP for any problem to receive a sequence of questions which will find the least common multiple in steps.

Grade Level: Intermediate algebra

Student Time: 30 minutes

Subject Area: Algebra

ecs: 4367

File Name: math95j
Adding Algebraic Fractions

Author: Richard Neapolitan, Wright College

Press HELP to be given the answer.

Add the following two expressions:

$$\frac{7}{2x^2} + \frac{5}{3xy} + \frac{3}{2x^2} + \frac{6}{3xy}$$

In this problem we work with each denominator. Before we can find the least common denominator, first we find the least common multiple of the denominators. This is called the least common denominator. What is it?

Press BACK to return to the table of contents.

Press HELP to be given the answer.

Add the following two expressions:

$$\frac{7}{2x^2} + \frac{5}{3xy} + \frac{3}{2x^2} + \frac{6}{3xy}$$

Each fraction is now changed into an equivalent fraction having the least common denominator of 6x²y. The sum of the two equivalent fractions is then simplified.

Press BACK to return to the table of contents.

Objective:

To present practice with help on addition of algebraic fractions.

Description:

- There are seven sections:
 - Problems like $4x/3 + 5x/4$
 - Problems like $7x/2 + 2x^2/3$
 - Problems like $3x/4 + 2y/5$
 - Problems like $2/5x + 5/3x$
 - Problems like $2/7x + 3/2xy$
 - Problems like $(3x + 2)/4x + (2y + 5)/3y$
 - Problems like $3/(x^2 - 4) + 2/(x^2 - 3x + 2)$
- In each section the student is shown how to add the algebraic fraction shown on the index. He must then add algebraic fractions of that same variety. He must do this three times without HELP to complete the section. He may, however, request HELP at any time to receive a sequence of questions which will lead him through the addition in steps.

Grade Level: Intermediate algebra

Student Time: 45 minutes

Subject Area: Algebra

ecs: 4623

File Name: lim1
Solving Fractional Equations

Author: Richard Neapolitan, Wright College

Press HELP to be given the answer to a question.

Solve the following equation:

$$\frac{6x-2}{4} + \frac{6x-3}{2} = \frac{4x+2}{6}$$

The L.C.D. is 12

$$\frac{12(6x-2)}{4} + \frac{12(6x-3)}{2} = \frac{12(4x+2)}{6}$$

Step 1. Multiply both sides of the equation by the L.C.D.

Do this step by yourself.

Press BACK to return to the table of contents.

Press HELP to be given the answer to a question.

Solve the following equation:

$$\frac{6x-2}{4} + \frac{6x-3}{2} = \frac{4x+2}{6}$$

The L.C.D. is 12

$$\frac{12(6x-2)}{4} + \frac{12(6x-3)}{2} = \frac{12(4x+2)}{6}$$

$$3(6x-2) + 6(6x-3) = 2(4x+2)$$

$$18x-6+36x-18 = 8x+4$$

$$54x-24 = 8x+4$$

$$46x = 28$$

$$x = 28/46$$

Exactly

Press NEXT to do another problem of this type.
Press BACK to return to the table of contents.

Objective:

To provide practice with help on solving fractional equations.

Description:

- There are three sections:
 - Problems like $(x + 3)/2 + (x + 5)/6 = (x + 1)/9$
 - Problems like $3/4x + 6/5x = 13/20$
 - Problems like $2/(x - 1) - 3/(x + 3) = 6/(x^2 + 2x - 3)$
- In each section the student is shown how to solve the equation listed on the index. He must then solve fractional equations of that type himself. He may press HELP to receive a sequence of questions which will lead to the solution. However, he must solve two equations without help to complete the section.

Grade Level: Intermediate Algebra

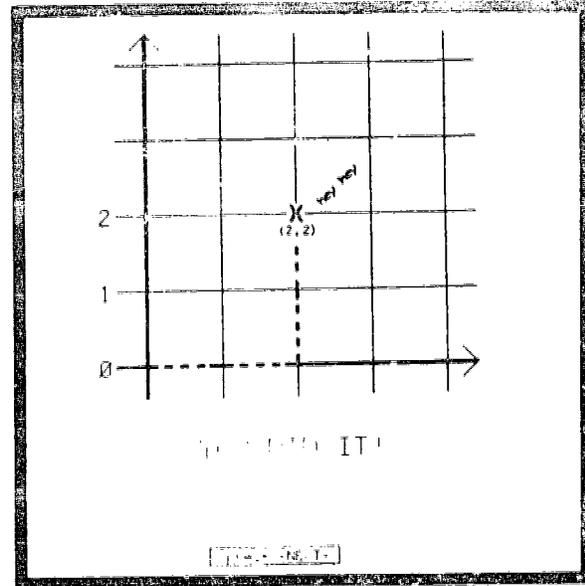
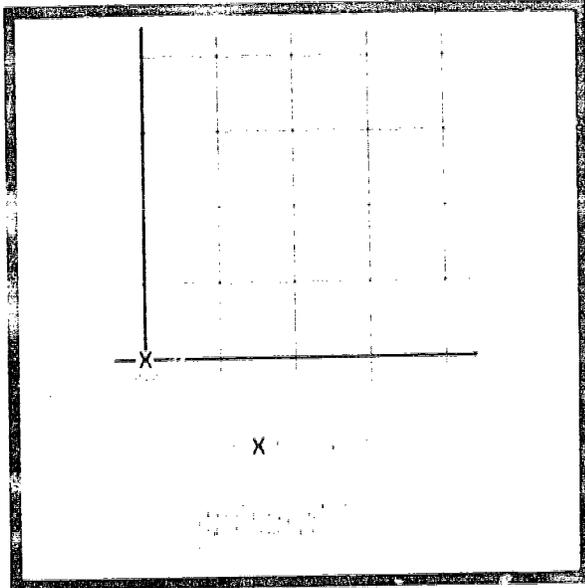
Student Time: 30 minutes

Subject Area: Algebra

ecs: 4705

File Name: remttt
How to Plot Points

Authors: Donald Cohen and Jerry Glynn, Elementary Math Group,
CERL
adapted by David Lassner, CERL



Objective:

To provide remediation in plotting points for students who have failed the checkup in cttttest several times.

Description:

1. The student is taught to move a cursor to a specified x,y location in a grid.
2. He is stepped through this process first, then he is asked to work several similar problems until he can work them without error.

Grade Level: Intermediate algebra

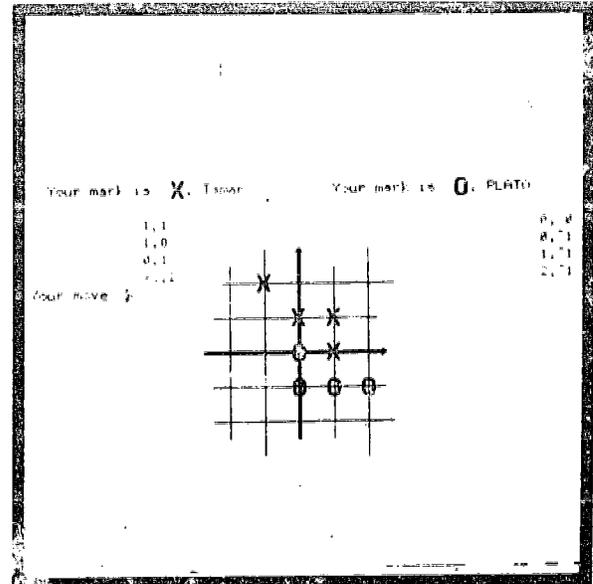
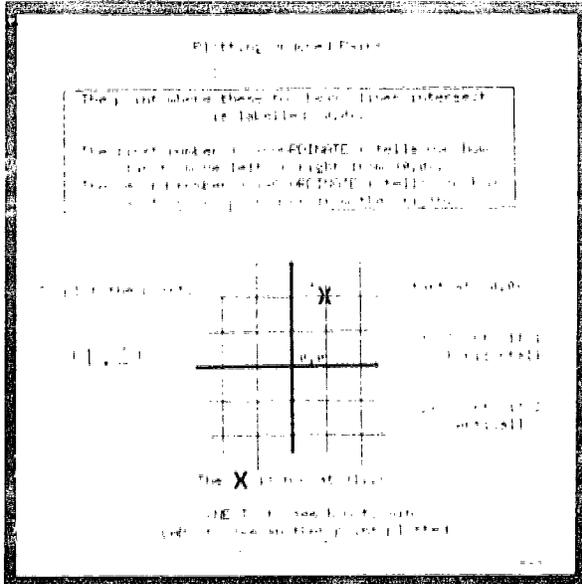
Student Time: 30 minutes

Subject Area: Algebra

ecs: 2679

File Name: ccttt
Tic-Tac-Toe

Authors: Donald Cohen and Jerry Glynn, Elementary Math Group,
CERL
adapted by David Lassner, CERL



Objective:

To teach plotting points on a grid by using a tic-tac-toe game format.

Description:

1. The student plays tic-tac-toe against PLATO on a 4×4 grid. The markers are placed at the grid points by giving the coordinates of the grid point.
2. Depending on the level of play the grid may include negative coordinates.

Grade Level: Intermediate algebra

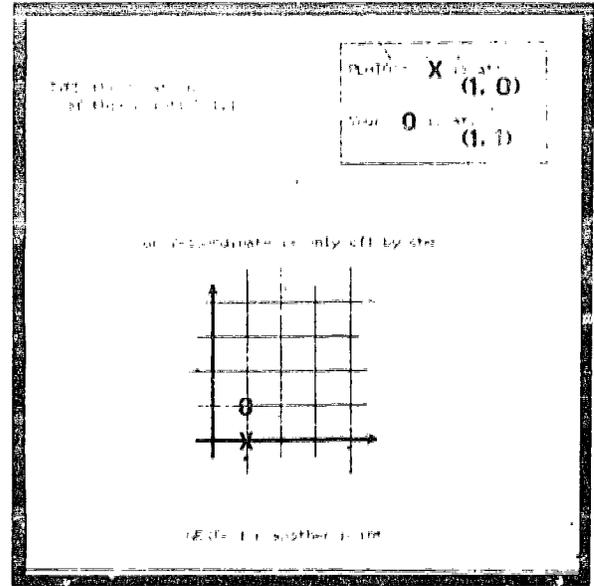
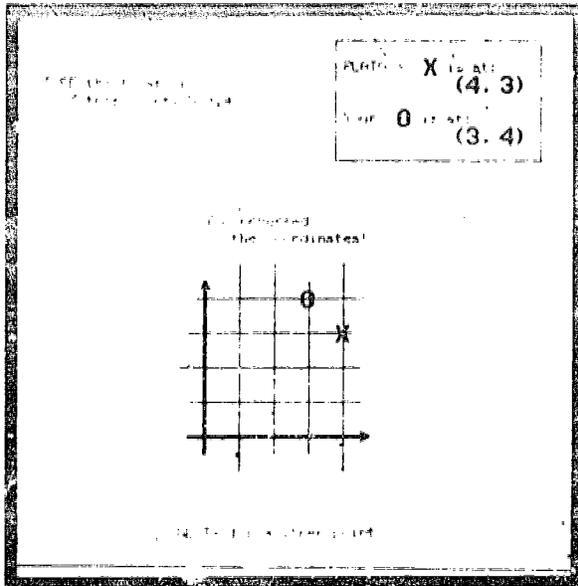
Student Time: 30 minutes

Subject Area: Algebra

ecs: 3249

File Name: c0ttttest
Plotting Points Checkup

Authors: Donald Cohen and Jerry Glynn, Elementary Math Group,
CERL
adapted by David Lassner, CERL



Objective:

To provide a checkup on the student's ability to plot points.

Description:

1. The student is asked to answer two types of questions:
 - a. Give the coordinates of a given point on a grid
 - b. Move a cursor on a grid to a point whose coordinates are given
2. To pass the checkup he must answer three out of four questions correctly.

Grade Level: Intermediate algebra

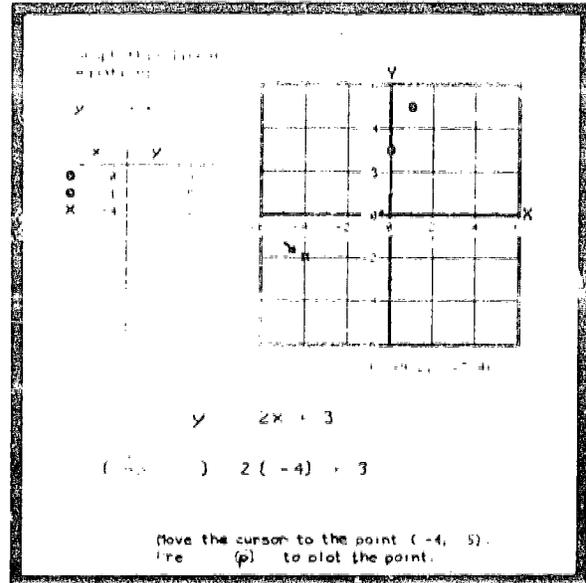
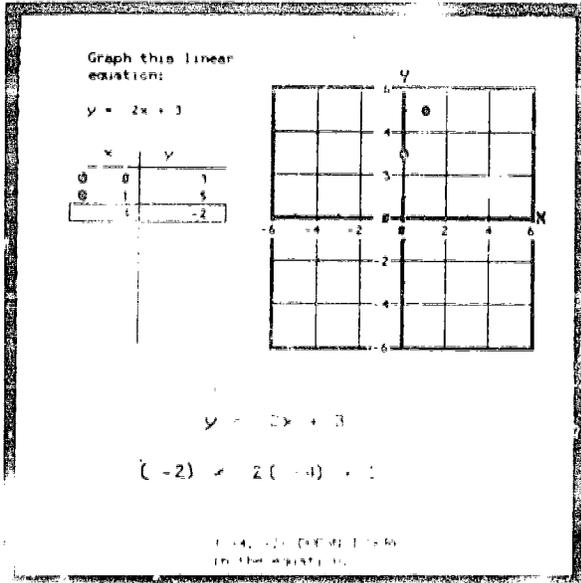
Student Time: 15 minutes

Subject Area: Algebra

ecs: 1560

File Name: line1
Graphing Straight Lines -- Table of Values

Author: Barbara Lederman, CERL



Objective:

To provide instruction and practice in getting a table of values satisfying a given equation of the form $y = mx + b$, and using it to graph the corresponding straight line.

Description:

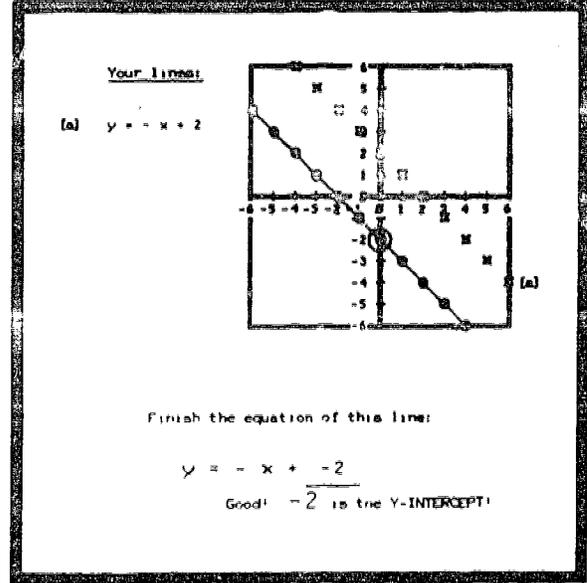
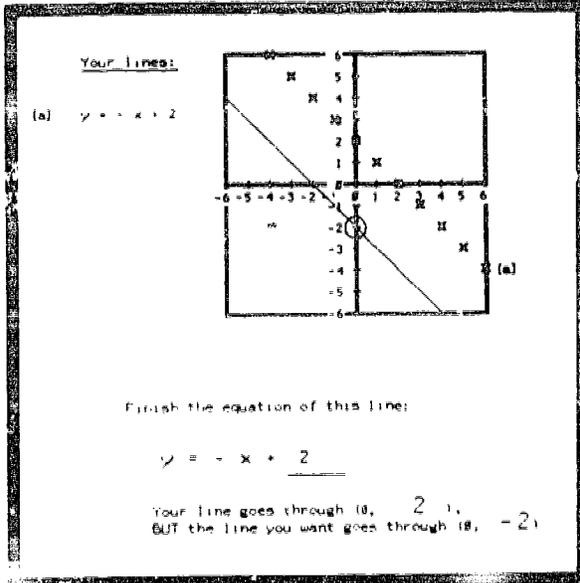
- There are three sections:
 - Getting the table of values
 - What's my line (graph it using the table of values)
 - What's my line (graph it by moving a cursor on a grid)
- In the first two sections the student is given a linear equation of the form $y = mx + b$ and required to provide x and y values to make a table of values that satisfy the given equation. As each pair is entered in the table it is automatically plotted on a grid.
- In the third section the student moves a cursor to plot points on a grid that satisfy a given linear equation of the form $y = mx + b$. In all three sections at least three correct points are required and all points are checked in the equation.

Grade Level: Intermediate Algebra Student Time: 30 minutes

Subject Area: Algebra ecs: 4713

File Name: line2
Intercept of Straight Lines

Author: Barbara Lederman, CERL



Objective:

To introduce the y-intercept and to provide instruction and practice in finding it from the graph of a linear equation.

Description:

1. There are two sections:
 - a. What is the y-intercept
 - b. What's my equation (fill in the y-intercept)
2. Section a starts by allowing the student to fill in the blank in an equation of the form $y = mx + \underline{\quad}$ and displaying the graph of that equation. In section b, he is taken through a series of exercises until he can determine the intercept by looking at the graph.

Grade Level: Intermediate algebra

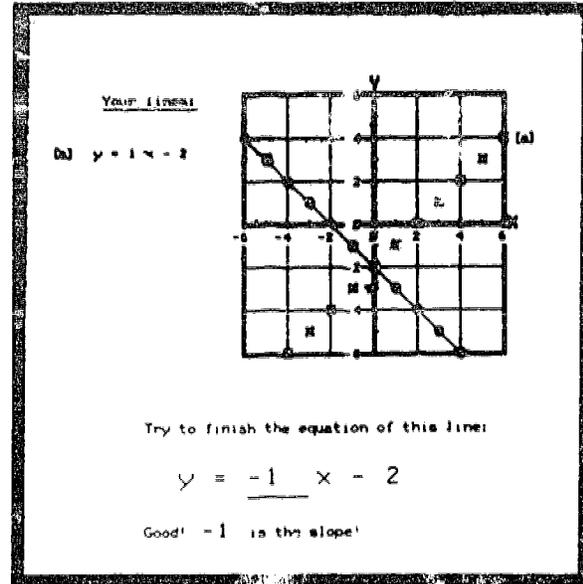
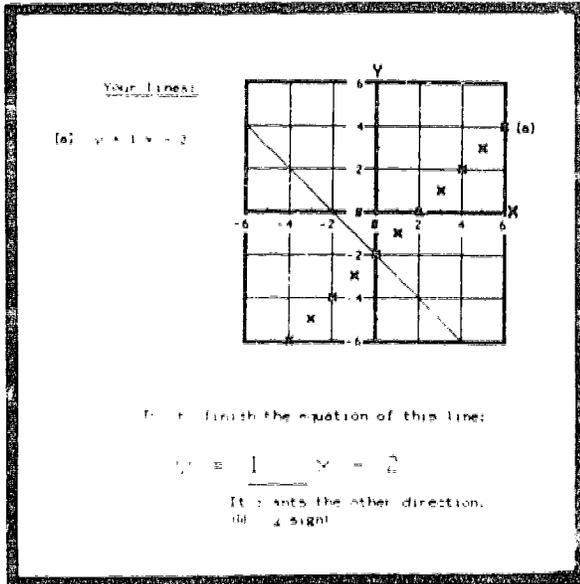
Student Time: 15 minutes

Subject Area: Algebra

ecs: 2123

File Name: line2a
Slope of a Line

Author: Barbara Lederman, CERL



Objective:

To introduce the slope and to provide instruction and practice in finding it from the graph of a linear equation.

Description:

1. In section a the student fills in the blank in equations of the form $y = \underline{\quad}x + b$ and the graph of the resulting equation is displayed on the grid.
2. Section b presents a trial-and-error drill where the student determines the slope from a graph. If the student types in an incorrect slope, the graph of the line with that slope is displayed on the grid.
3. Section c presents the rise-over-run definition of slope.
4. Section d develops the two-point formula for slope.

Grade Level: Intermediate Algebra

Student Time: 30 minutes

Subject Area: Algebra

ecs: 4462

File Name: line1a
Point-Slope Form

Authors: LaVerne McFadden, Parkland College, Keith Bailey,
CERL, and Barbara Lederman, CERL
programmed by David Lassner

THE POINT-SLOPE FORM

Notice that the slope m and both coordinates of the point (x_1, y_1) are used in the equation.

$$y - y_1 = m(x - x_1)$$

$\begin{array}{ccc} \swarrow & & \searrow \\ \text{y-coordinate} & & \text{x-coordinate} \\ \swarrow & & \searrow \\ y_1 & & x_1 \end{array}$

Use this method to write the equation of a line given the slope and a point.

Suppose that the slope is m and the point is (x_1, y_1) .

Write an equation of the line.

Write an equation of the line through $(-4, -3)$ with slope $1/2$.

If the slope is a fraction, enclose it in parentheses.

$$y - y_1 = m(x - x_1)$$

Fill in the blank:

You need to answer 3 without **HELP**. So far, you have 0.

Objective:

Given two points or one point and the slope, the student will be able to write an equation of the corresponding line.

Description:

1. There are two sections:
 - a. Given the slope and a point, write an equation
 - b. Given two points, write an equation.
2. Each section contains instruction and practice exercises all of which can be accessed from an index.
3. In the practice exercises, the student can step through a problem by pressing the HELP key. He is required to do three problems without help in each section to complete the lesson.

Grade Level: Intermediate algebra

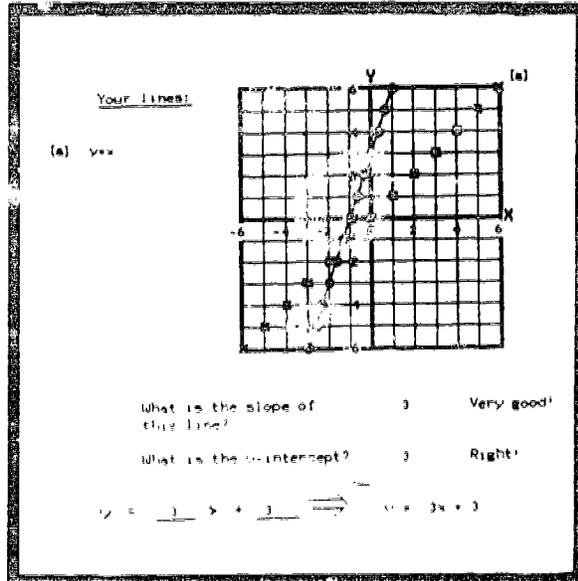
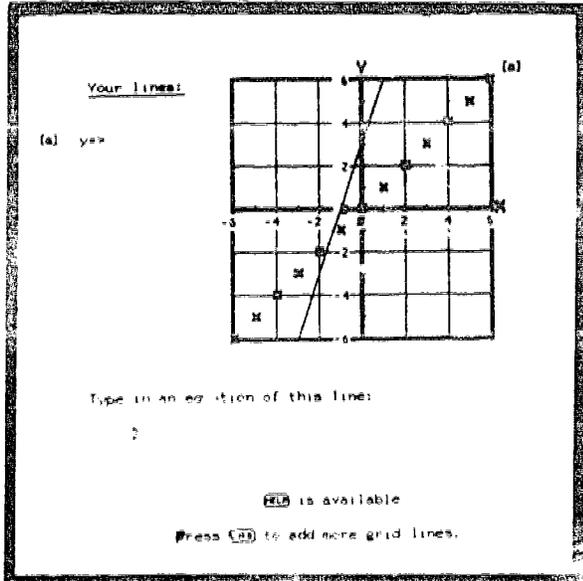
Student Time: 30 minutes

Subject Area: Algebra

ecs: 1976

File Name: line3
Graphing Any Line in the Form $y = mx + b$

Author: Barbara Lederman, CERL



Objective:

To provide practice in using the slope and intercept to find the equation of a given straight line or to graph a given linear equation.

Description:

1. There are four sections:
 - a. Summary of intercept and slope
 - b. What's my equation (type it)
 - c. Graphing hints
 - d. What's my line (graph it)
2. In the first section, the student is given equations in the form $y = mx + b$ or ax which he must give the slope and the y-intercept.
3. In the second section, the student is given the graph of a straight line and he must type in a linear equation with that graph.
4. The third section helps the student step-by-step to graph a linear equation by using the y-intercept and the slope.
5. In the fourth section he is given a linear equation and he must graph it by plotting at least three correct points on a grid. The student is expected to make use of the concepts and techniques learned in the previous line lessons.

Grade Level: Intermediate algebra

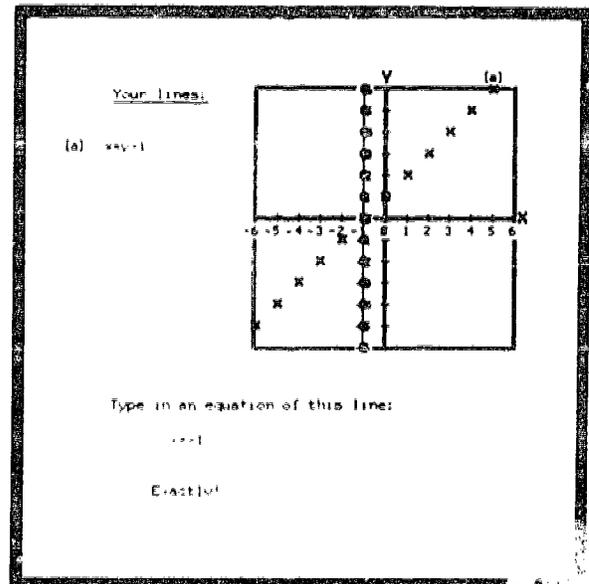
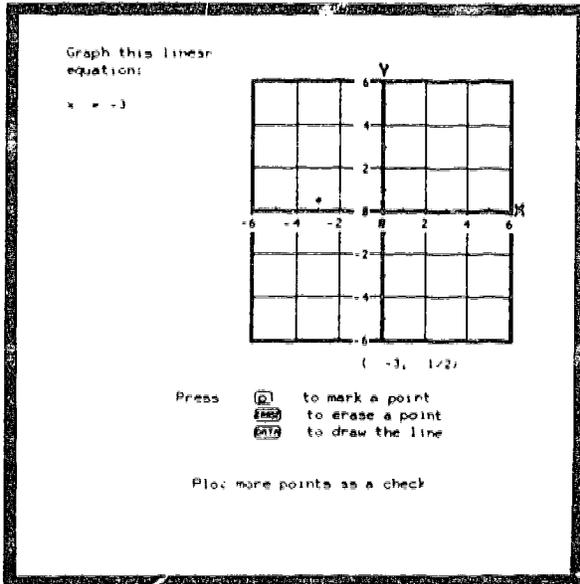
Student Time: 30 minutes

Subject Area: Algebra

ecs: 3987

File Name: line4
The Lines $y = b$ and $x = c$

Author: Barbara Lederman, CERL



Objective:

To introduce the lines $y = b$ and $x = c$ and to drill the student in graphing any such equation and in finding the equation of any horizontal or vertical line.

Description:

- There are four sections:
 - Type the equation (horizontal lines)
 - Graph the equation (horizontal lines)
 - Type the equation (vertical lines)
 - Graph the equation (vertical lines)
- These sections introduce horizontal and vertical lines and present drills similar to those used in earlier lessons.

Grade Level: Intermediate algebra

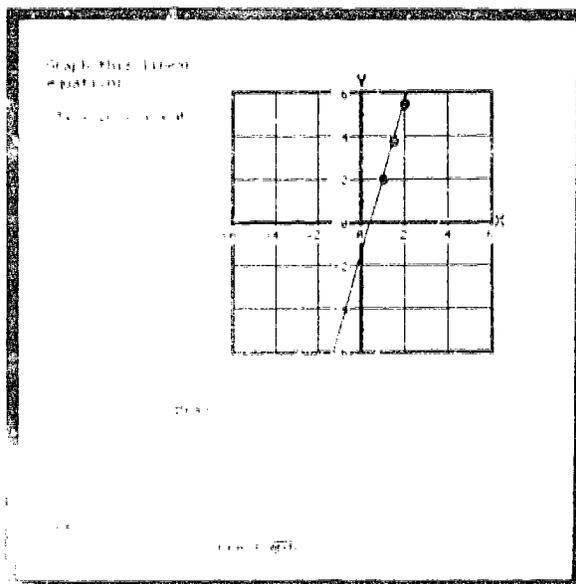
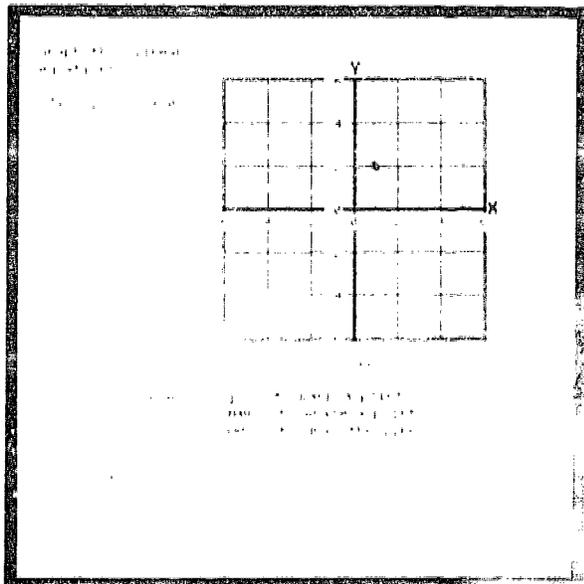
Student Time: 30 minutes

Subject Area: Algebra

ecs: 3634

File Name: line5
Graphing Lines in the Form $ax + by + c = 0$

Author: Barbara Lederman, CERL



Objective:

To enable the student to convert a linear equation in the form $ax + by + c = 0$ to the form $y = mx + b$ and thereby identify its slope and intercept and be able to graph it.

Description:

1. There are five sections:
 - a. Find a , b , c
 - b. Change $ax + by + c = 0$ to form $y = mx + b$
 - c. What's my slope
 - d. What's my intercept
 - e. What's my line (graph it)
2. In the first two sections the student is taught to convert a linear equation from the form $ax + by + c = 0$ to $y = mx + b$.
3. In the last three sections the equations are given in the a , b , c , form and the drills are otherwise the same as in earlier like lessons.

Grade Level: Intermediate algebra Student Time: 60 minutes

Subject Area: Algebra ecs: 355

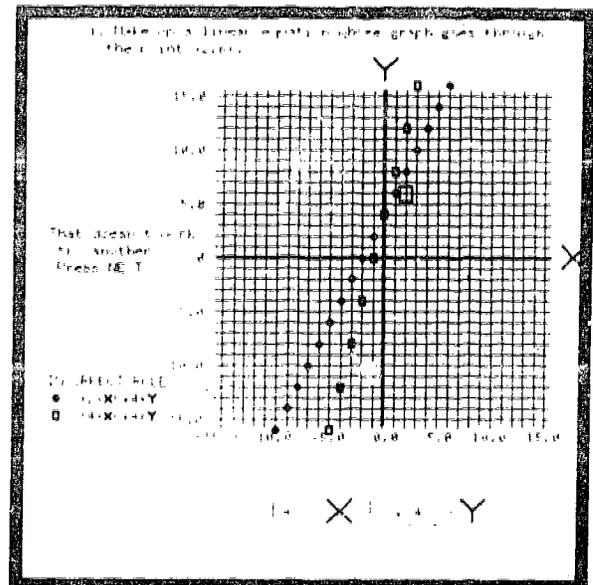
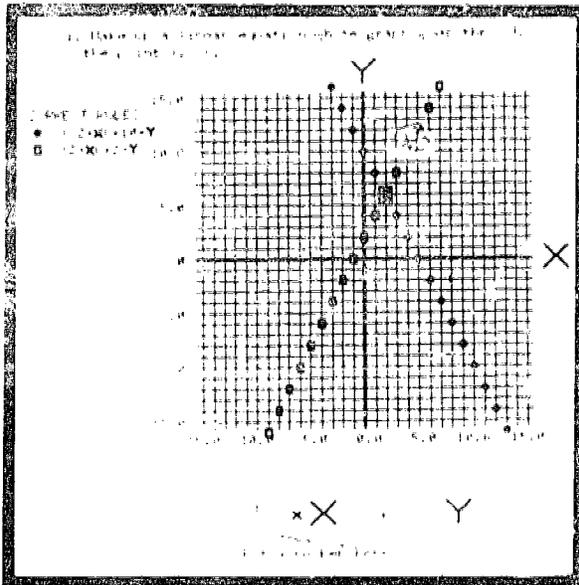
Special Notes:

At this time all lines presented in this lesson can be converted to the form $y = mx + b$. At some time in the future, vertical lines in the form $ax + by + c = 0$ will be added to this lesson.

File Name: line7

More Exercises on Linear Equations and Straight Lines

Authors: Donald Cohen and Jerry Glynn, Elementary Math Group, CERL



Objective:

To provide a series of problems which require the consolidation of all previously learned skills in graphing straight lines.

Description:

1. There are seven sections:
 - a. Give the equation of a line through a given point.
 - b. Give the equation of a line flatter than a given line.
 - c. Give the equation of a line with the same slope as a given line.
 - d. Give the equation of a line that meets a given line in a given point.
 - e. Give the equation of a line through two given points.
 - f. Give the equation of a line perpendicular to a given line.
 - g. Give the equation of a line through three given points.
2. In each section, the student works with three specific instances of the given type of question.

Grade Level: Intermediate algebra

Student Time: 60 minutes

Subject Area: Algebra

ecs: 2054

File Name: simequ
Introduction to Systems of Equations

Author: Barbara Lederman, CERL

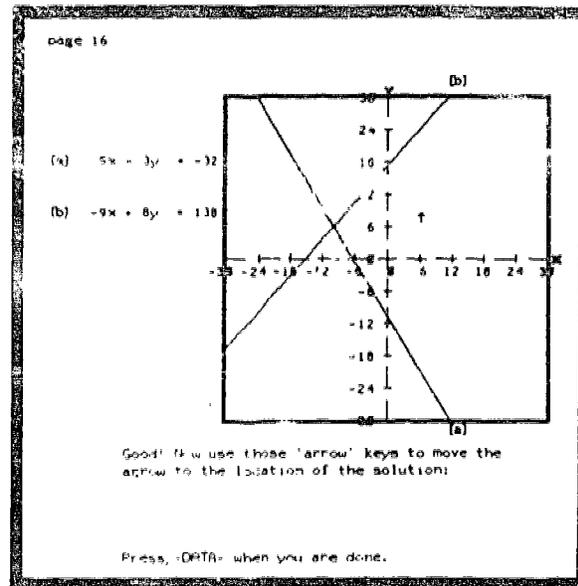
page 17

If we have a solution to a system,
then it must satisfy both equations:

Example: $-5x - 8y = 21$
 $-4x - 5y = 21$

If $(-9, 3)$ is a solution, then:

$$-5(-9) - 8(3) = 21$$

$$-4(-9) - 5(3) = 21$$


Objective:

To provide an introduction to systems of linear equations with emphasis
the geometric meaning of the solution to a 2×2 system.

Description:

Several large systems are shown. 2×2 systems are discussed.
Solutions to a system are shown to be intersections of pairs of lines.

Grade Level: Intermediate algebra

Student Time: 15 minutes

Subject Area: Algebra

ecs: 3140

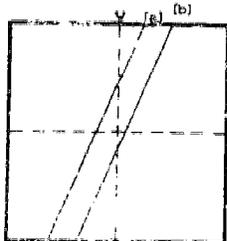
File Name: simequ1
Independent Systems of Equations and Numbers of Solutions

Author: Barbara Lederman, CERC

page 19

II.

If the two lines don't intersect in any point,....



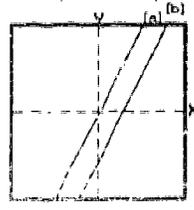
the system has 0 solutions(a),
and the system is inconsistent

There are NO points that are in BOTH lines.

page 20

In each of the following, type

1) if the system is independent,
2) if the system is inconsistent,
3) if the system is dependent.



1) independent
2) inconsistent
3) dependent

Objective:

To familiarize the student with the geometry (graphs) of three different types of systems: independent, inconsistent, and dependent as well as the number of solutions for each type.

Description:

Two series of drills are presented:

- A graph (no equations) is presented. The student enters which type of system it represents and how many solutions it has.
- Only the equations are presented and ratios of coefficients are discussed. The students give system type and number of solutions as before.

Grade Level: Intermediate algebra

Student Time: 30 minutes

Subject Area: Algebra

ecs: 3826

File Name: simequla
How to Write Solutions to Systems of Equations

Author: Barbara Lederman, CEBL

Page 33

Inconsistent systems: NO solutions

(a) $x + y = 2$

(b) $4x + 2y = 45$

What is the solution?

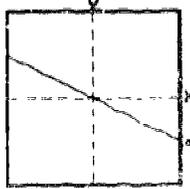
none

Page 34

Dependent system: MANY solutions

(a) $x + 2y = 8$

(b) $-x + 2y = 8$



Every point on that line is a solution.

What is the solution?

any (x, y) such that $x + 2y = 8$

Give 3 points that are on the "solution" line.

$(0, 4)$	point
$(2, 0)$	point
$(4, 0)$	no point

Give 3 points that are NOT on the "solution" line.

Objective:

To provide directions and practice in typing in solutions to the three types of systems.

Description:

1. There are three sections:
 - a. Independent
 - b. Inconsistent
 - c. Dependent
2. A help sequence is available for the dependent system section.

Grade Level: Intermediate algebra

Student Time: 15 minutes

Subject Area: Algebra

ACS: 3072

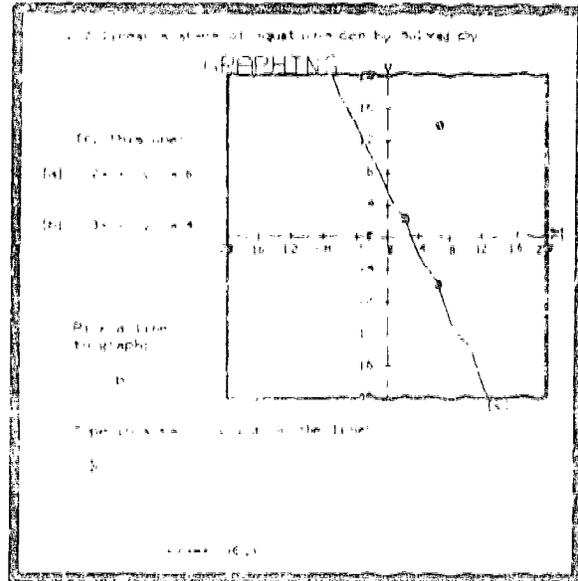
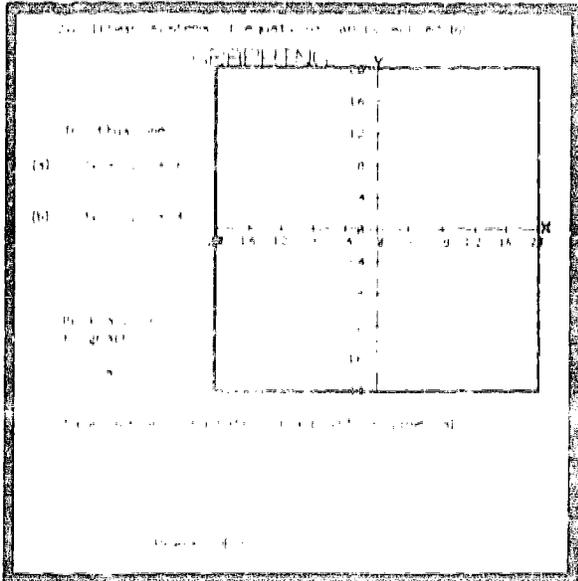
Special Notes:

Solutions to the systems are given as follows:

- a. Independent systems: an order pair
- b. Inconsistent systems: the word "none"
- c. Dependent systems: first either equation is typed; then three points on the "solution" line must be given.

File Name: slmequ2
Solving 2×2 Systems by Graphing

Author: Barbara Bedeman, CTRU



Objective:

To provide instruction in solving 2×2 linear systems by graphing.

Description:

The student graphs one equation at a time, and then estimates the solution to the system by reading the graph.

Grade Level: Intermediate Algebra

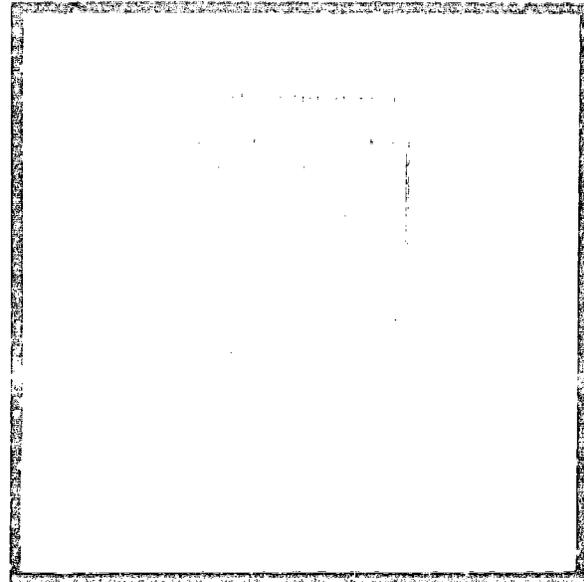
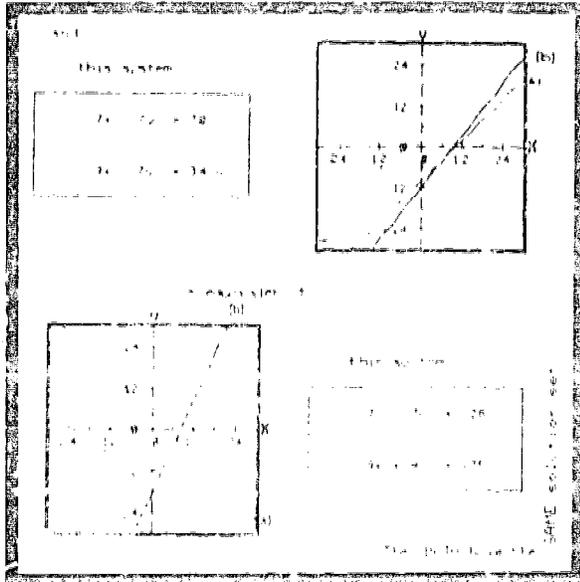
Student Time: 30 minutes

Subject Area: Algebra

eps: 2611

File Name: simequ3
 Introduction to Algebraic Methods of Solving
 2 x 2 Systems

Author: Barbara Lederman, CERL



Objectives:

1. To provide motivation for learning algebraic methods for solving systems of equations.
2. To promote an understanding of why the methods work through the use of graphs.

Descriptions:

1. Several systems are presented which can almost be solved by inspection. The student solves these with any requested help.
2. The idea of equivalent systems is presented using equations and graphs.
3. The student is told that algebraic methods can be used to change "ugly" systems into equivalent systems whose solutions are easy to read.

Grade Level: Intermediate Algebra

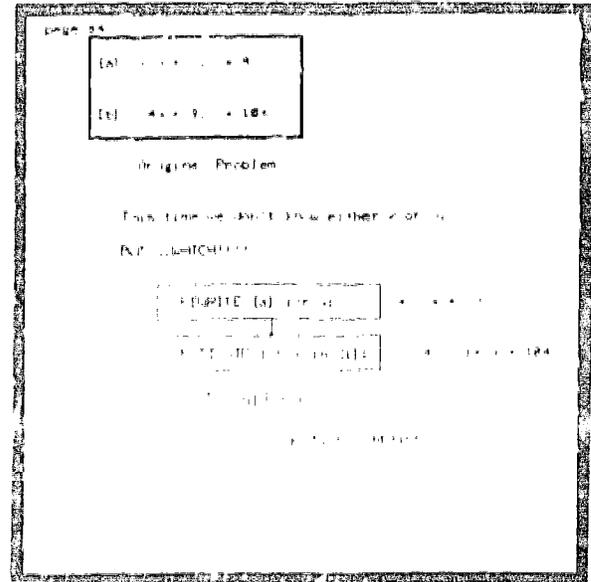
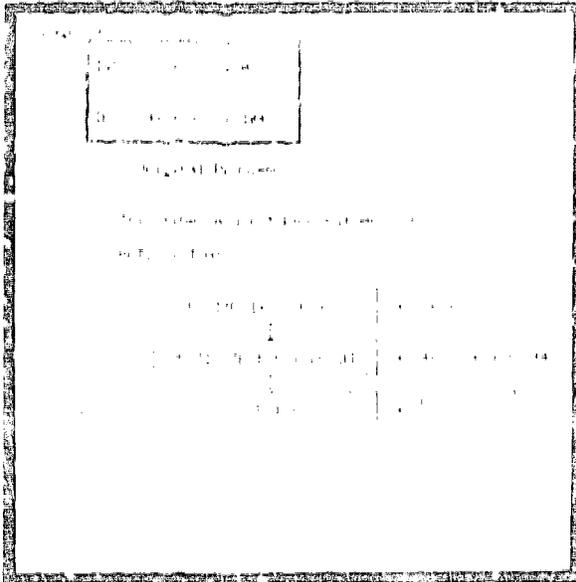
Student Time: 30 minutes

Subject Area: Algebra

ecs: 3459

File Name: simeq14
Solving 2×2 Systems by Substitution

Author: Barbara Laderman, CERL



Objective:

To provide instruction and exercises in solving 2×2 systems of linear equations using the substitution method.

Description:

1. The substitution method is presented step-by-step using flowcharts. The student then practices each step typing in the resulting equations. Graphs are used to picture what is happening to the system.
2. Dependent and inconsistent systems are also solved.

Grade Level: Intermediate Algebra

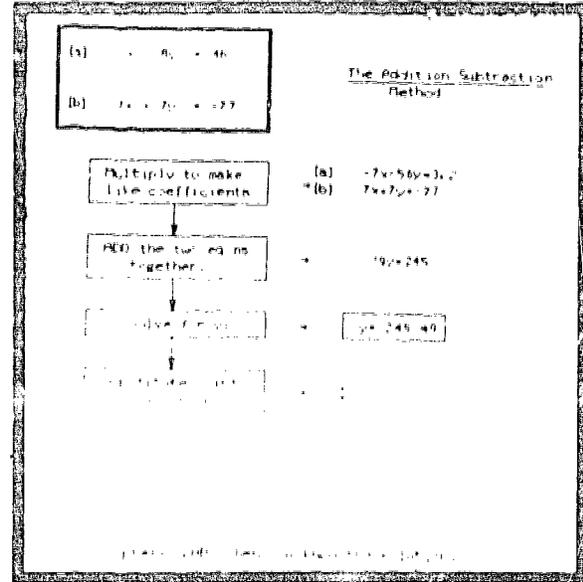
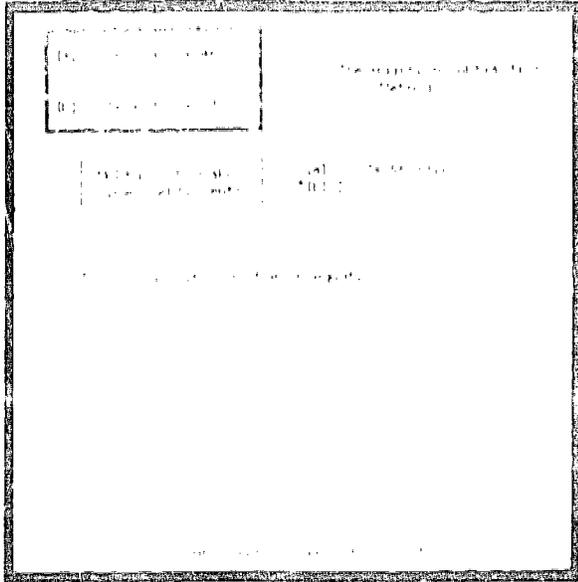
Student Time: 45 minutes

Subject Area: Algebra

ecs: 5560

File Name: sircop:6
Solving 2×2 Systems by the Addition-Subtraction Method

Author: Barbara Lederman, CERL



Objective:

To provide instruction and exercises in solving 2×2 systems of linear equations using the addition-subtraction method (this method is also known as the method of linear combinations).

Description:

1. The addition-subtraction method is presented step-by-step using flowcharts.
2. The student then practices each step, typing in the resulting equations. Graphs are used to picture what is happening to the system.
3. Independent, dependent, and inconsistent systems are presented.

Grade Level: Intermediate algebra

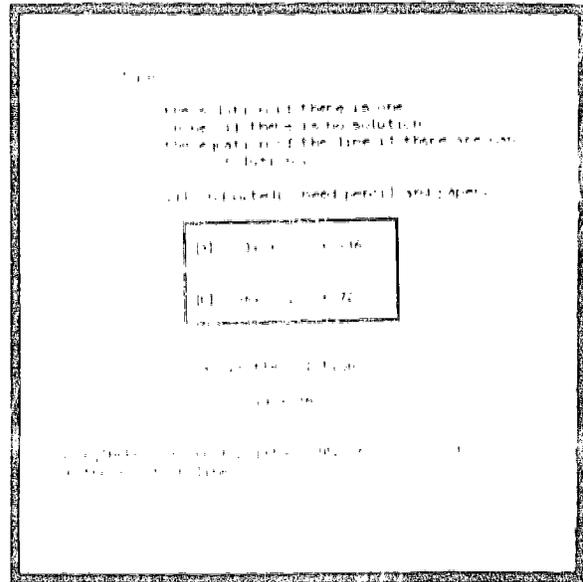
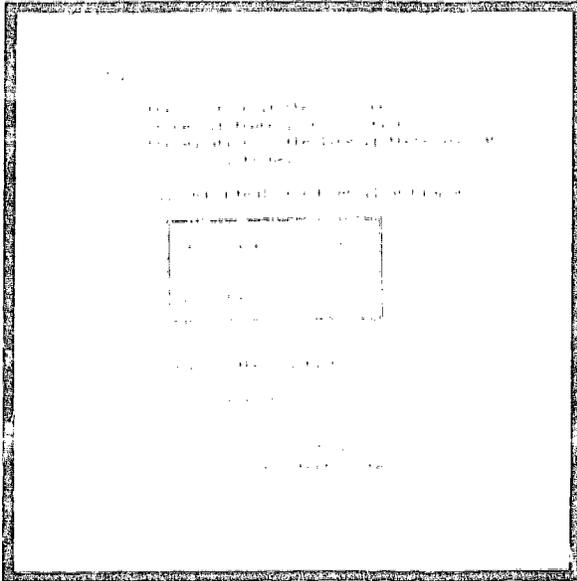
Student Time: 45 minutes

Subject Area: Algebra

ecs: 5344

File Name: simequ6
Exercises on Solving 2×2 Systems of Equations

Author: Barbara Lederman, CERL



Objective:

To provide practice in solving each type of 2×2 system of linear equations: independent, inconsistent, and dependent.

Description:

This lesson is strictly a drill. No instruction is provided. A student gives solutions to systems of equations.

Grade Level: Intermediate algebra

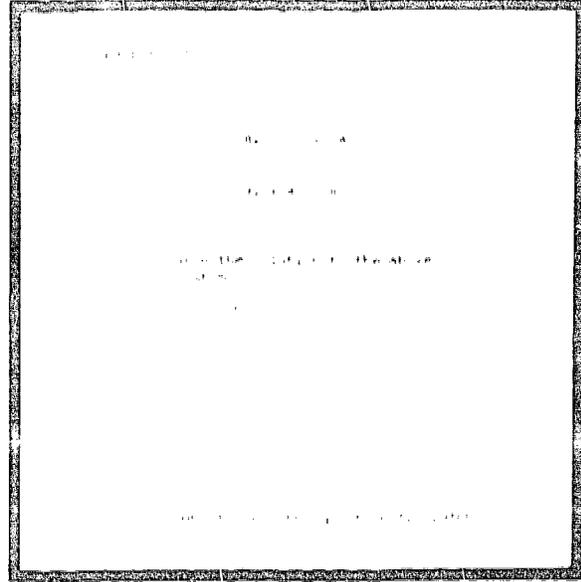
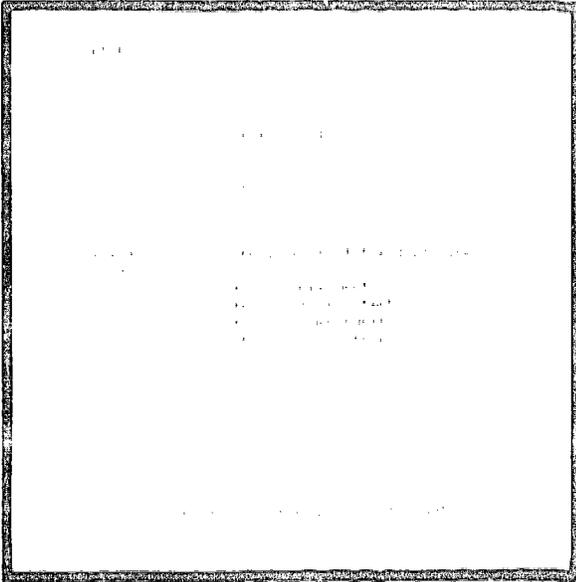
Student Time: 15 minutes, minimum

Subject Area: Algebra

ecs: 2572

File Name: sintest
Posttest for Simultaneous Equations

Author: Barbara Lederman, CERL



Objective:

To provide a posttest for the sequence of PLATO lessons on simultaneous equations.

Description:

1. The test consists of twelve questions. There are two multiple choice questions, six yes or no type questions, and four questions where the student must give the solution to a system.
2. The student can skip any question by pressing LAB and return to that question later.
3. Within each problem type, parameters for the exercises are randomly generated so that new questions will be presented to students who repeat the test.

Grade Level: Intermediate algebra

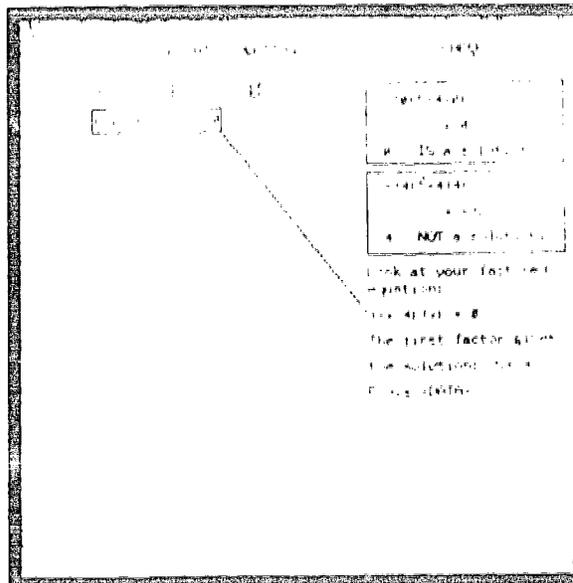
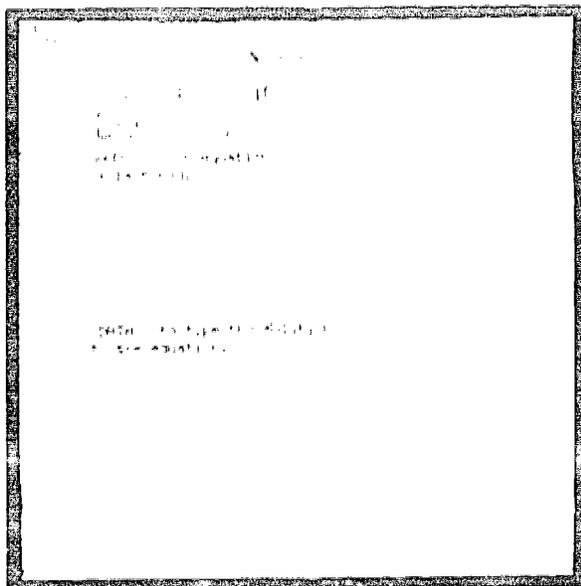
Student Time: 15 - 20 minutes

Subject Area: Algebra

ecs: 2821

File Name: quad3
Solving Quadratic Equations by Factoring

Author: Louis V. DiBello, CERL



Objective:

To give drill practice in solving quadratic equations by factoring.

Description:

1. There are five sections:
 - a. A guide for these drills
 - b. Equations like $3x^2 - 5x = 0$
 - c. Equations like $x^2 - x + 2 = 0$
 - d. Equations like $-2x^2 + 5x + 3 = 0$
 - e. Equations like $10x^2 - 31x - 63 = 0$
2. In each of the drill sections the problems are generated at random, and the student may work as many problems as he wants.
3. The student can choose to give the solutions right away or to factor the equation first. Any solution he gives is checked by plugging it into the equation and the student is shown this check.
4. If the student cannot give the solutions, he is required to factor the equation first. Incorrect factorizations are multiplied out for the student and saved on the screen.
5. After four incorrect factorizations, the correct factorization is given and the student is required to solve the equation. After three incorrect attempts to give a solution, the factorization is analyzed to find a solution from it.

Grade Level: Intermediate algebra

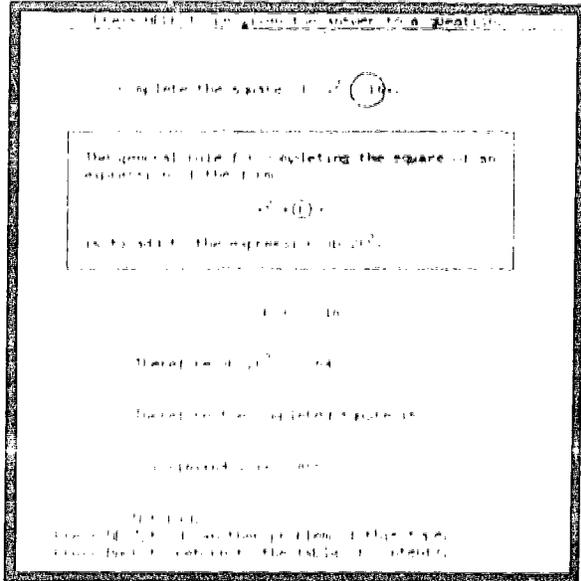
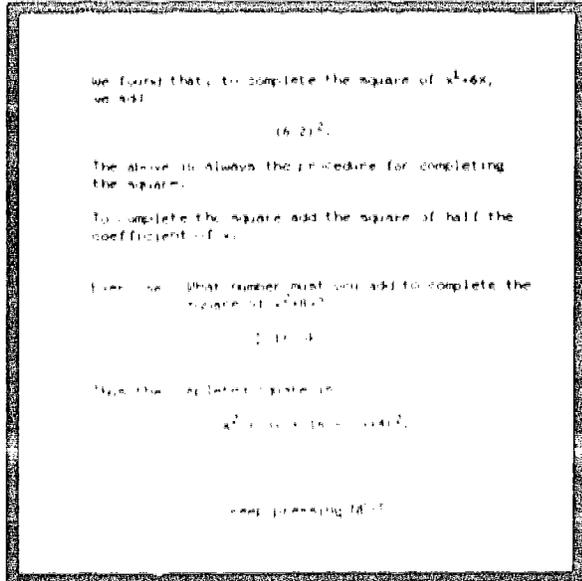
Student Time: 60 minutes

Subject Area: Algebra

ecs: 3370

File Name: math95m
Solving Quadratic Equations by Completing the Square

Author: Richard Neapolitan, Wright College



Objectives:

1. To present an introduction and practice with help on completing the square.
2. To present practice with help in solving quadratic equations by completing the square.

Description:

1. There are two sections:
 - a. Completing the Square
 - b. Solving by Completing the Square
2. In section a the student is shown how to complete the square. He must then complete four squares himself without HELP to complete the section. He may, however, press HELP to receive a sequence of questions which will complete the square in steps.
3. In section b he is shown how to solve a quadratic equation by completing the square. Again he must solve four problems without HELP, but may request HELP to solve any particular problem.

Grade Level: Intermediate algebra

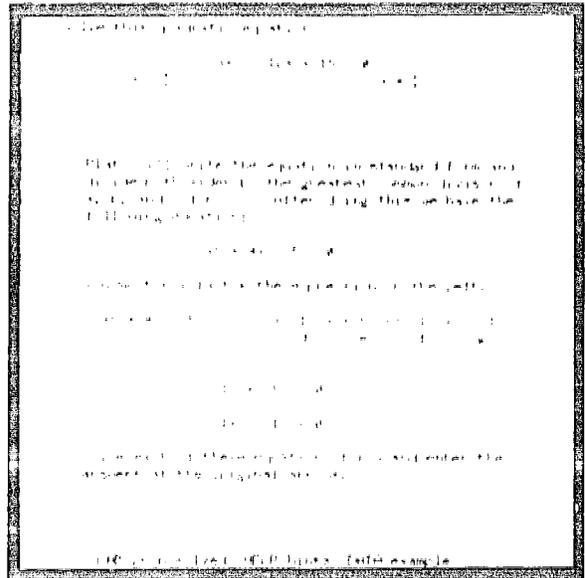
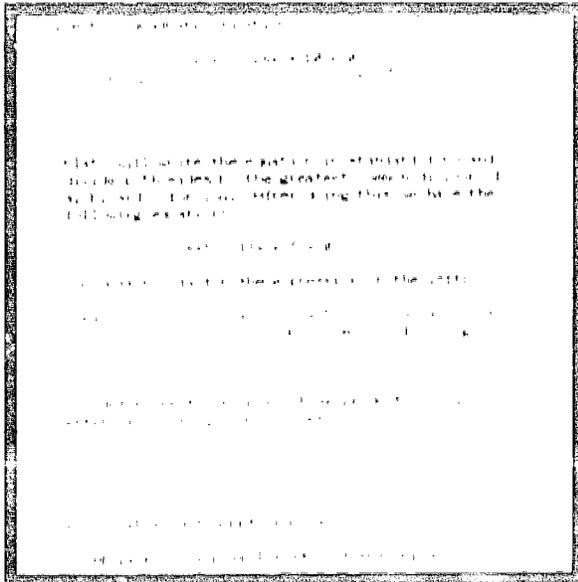
Student Time: 30 minutes

Subject Area: Algebra

ecs: 4668

File Name: solquad
Solving Quadratic Equations by Factoring

Author: Richard Neapolitan, Wright College



Objective:

To present practice exercises with help on solving quadratic equations by factoring.

Description:

1. The student is first shown, step-by-step, how to solve a quadratic equation by factoring. He must then solve quadratic equations himself. He can press LAB to see the equation solved in steps, or HELP to receive a sequence of questions and arrows which lead to the solution.
2. He must solve two equations without any help to complete the lesson.

Grade Level: Intermediate Algebra

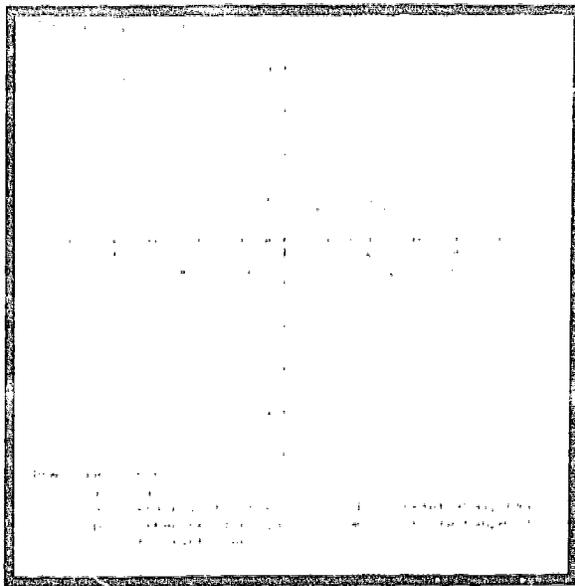
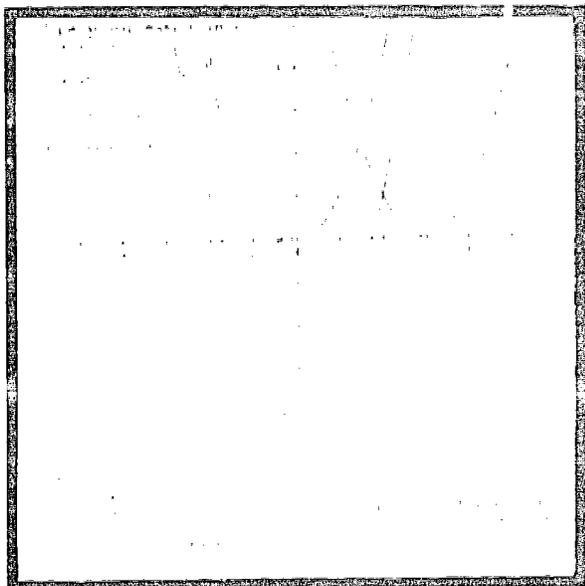
Student Time: 30 minutes

Subject Area: Algebra

ecs: 3080

File Name: ceplot
Function Plotter

Author: Keith Bailey, CERL
section four designed and programmed by Dan Sleator,
CERL



Objective:

To provide a function plotter for the students to use.

Description:

1. There are four main sections.
 - a. $y = f(x)$: y a function x
 - b. $r = f(t)$: polar functions
 - c. $x = f(t), y = g(t)$: parametric equations
 - d. Implicit functions
2. In each section the student can type in any function or equation of the appropriate type and PLATO will graph it on a grid. The student can graph several functions on the same grid for purposes of comparison, and he can choose the x and y scales.
2. A section containing instructions is available from the index or by pressing the HELP key.

Grade Level: High School and above

Student Time: open-ended

Subject Area: Function Plotting

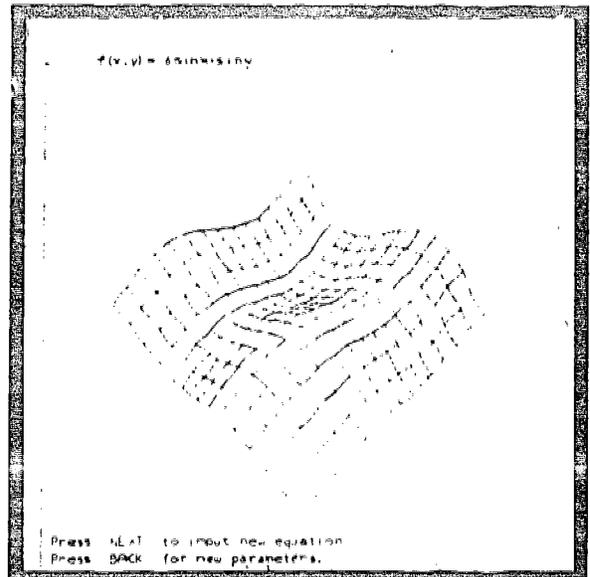
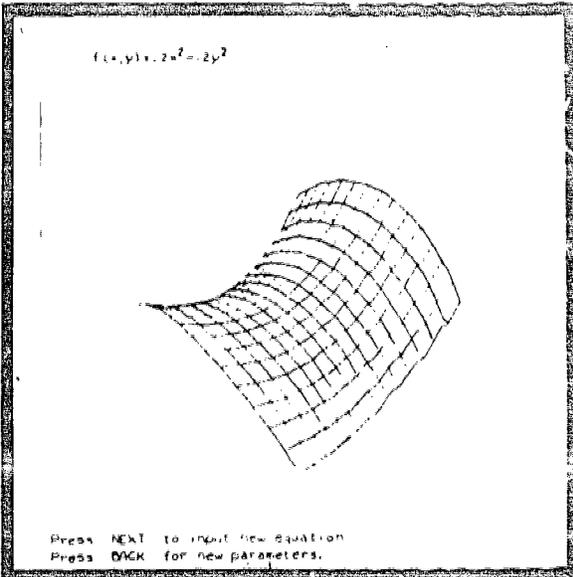
ecs: 2954

Special Notes:

Previously entered formulas can be recalled and modified using the COPY, EDIT, and ERASE keys. Use of this lesson has been most effective when students were provided by their instructors with sequences of equations to be graphed.

File Name: plot3
Three-Dimensional Function Plotter

Author: James Bowery, RIIRC



Objective:

To provide a three-dimensional surface plotter.

Description:

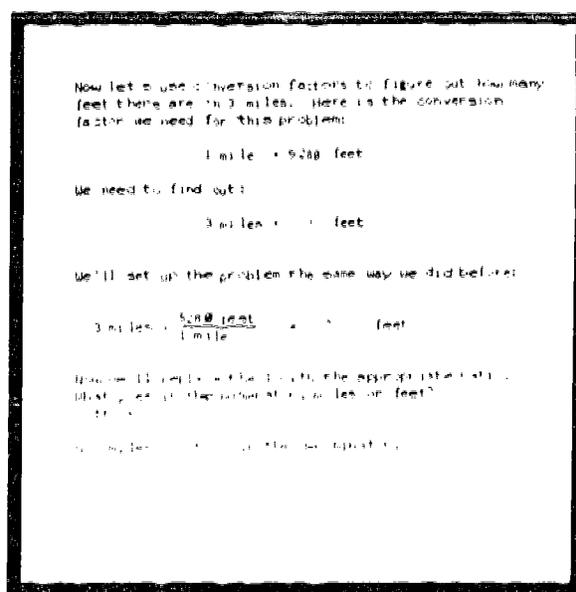
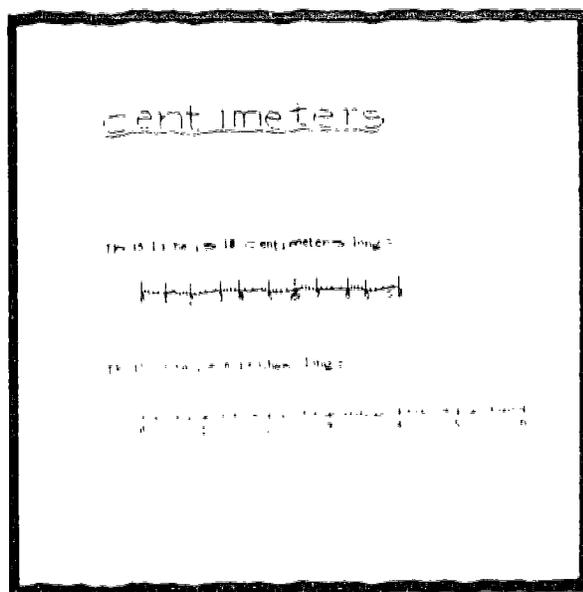
An expression in x and y , coordinates of the observation point, and size can be entered. The corresponding surface is then plotted.

Grade Level: Community College and above Student Time: open

Subject Area: Graphing functions ecs: 951

File Name: liter
Introduction to the Metric System

Author: Rutā Chabay, Department of Chemistry, University of
Illinois at Urbana-Champaign



Objective:

To present an introduction and practice on metric measures and conversions.

Description:

1. Instruction and practice on metric measures of distance, weight, volume, and temperature.
2. Covers conversions within the metric system and conversion between metric and English units.

Grade Level: Basic mathematics

Student Time: 30 minutes

Subject Area: Arithmetic

ecs: 5521

Special Notes:

Contains an index from which each topic can be accessed.

File Name: introtrig1
Introduction to Trigonometry

Author: Richard Neapolitan, Wright College

Objective:

To provide an introduction to the basic concepts of angles, triangles, and the terminology used in defining sine, cosine, and tangent of angles in a right triangle.

Description:

There are four sections, each of which is available from an index.

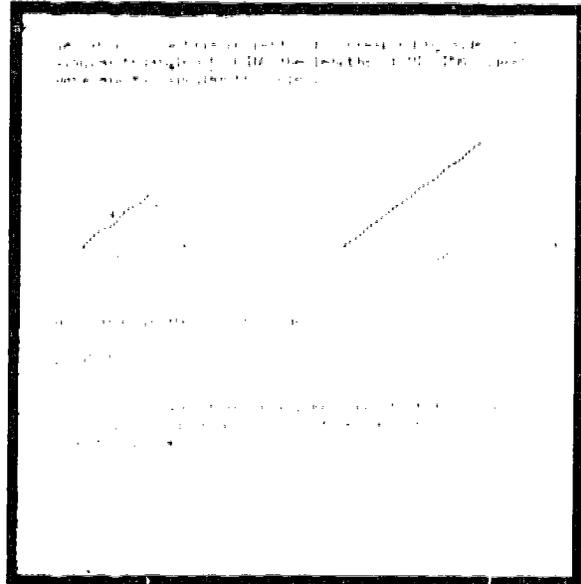
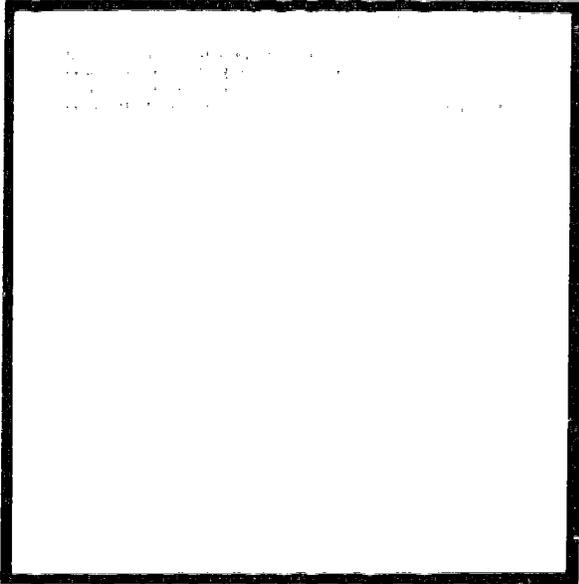
- a. Angle. The meaning of "angle" and measuring angles in degrees, based on dividing a circle into 360 equal parts, are presented.
- b. Triangle. The student is asked to select figures which are triangles from a display of a variety of plane figures. Exercises based on the fact that the sum of the angles in a triangle is 180 degrees are given.
- c. Right triangles. The definition and examples are given.
- d. Basic trigonometric concepts. Instruction and exercises on hypotenuse, side opposite an angle, and side adjacent to an angle are given. Sine, cosine, and tangent of angles in a right triangle are defined and the student is asked to compute these values for triangles with given sides and angles.

Grade Level: High School and above Student Time: 30 minutes

Subject Area: Trigonometry ecs: 4526

File Name: trig1
Similar Triangles and Pythagorean Theorem

Authors: Paul Thompson, Parkland College, and Robert Baillie, CERL
programmed by Robert Baillie, CERL



Objective:

To provide review of geometric concepts prerequisite to trigonometry.

Description:

1. Review of the concepts of acute, obtuse, and right triangles.
2. Introduction to similar triangles and corresponding parts in them. The student is asked to rotate one triangle until it is in the same position as a similar triangle (see picture).
3. The student calculates ratios of sides and finds missing sides by similarity.
4. The Pythagorean Theorem is presented -- along with the terminology: hypotenuse, opposite side, adjacent side, opposite angle, adjacent angle.

Grade Level: High School and above

Student Time: 40 minutes

Subject Area: Trigonometry

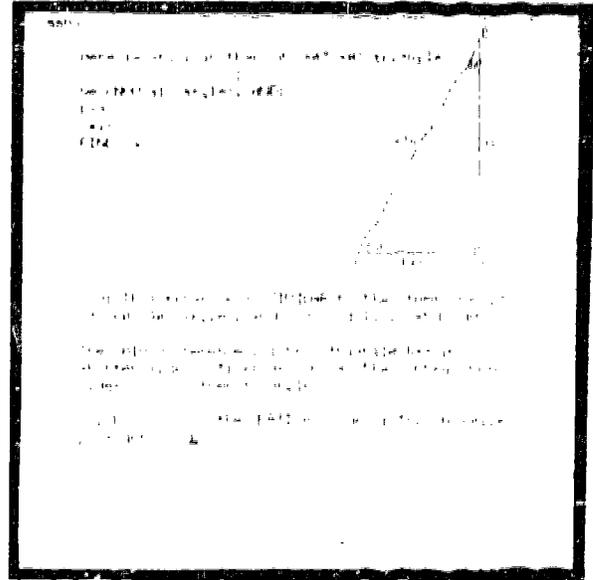
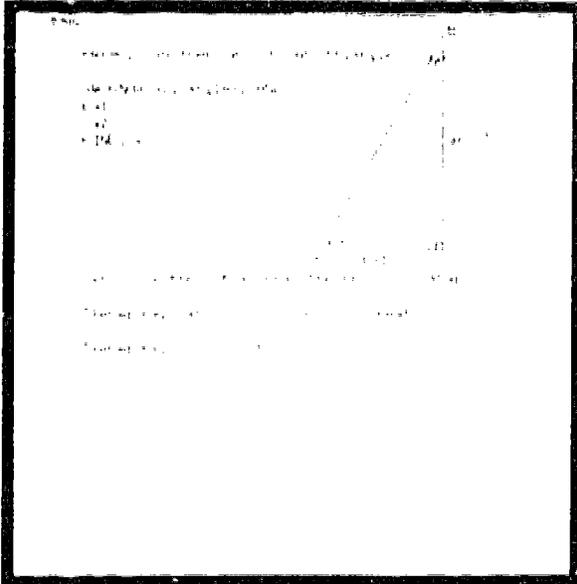
ecs: 4024

Special Notes:

The student gets an index and can review the sections in any order.

File Name: trig2
Special Right Triangle

Authors: Paul Thompson, Parkland College, and Robert Baillie, CERL
programmed by Robert Baillie, CERL



Objective:

To familiarize the student with facts about right triangles.

Description:

1. Instruction in typing the degree symbol ($^{\circ}$), and a proof for "The sum of the angles of a triangle equals 180° " are provided.
2. Properties of the 90° - 45° - 45° and 90° - 60° - 30° right triangles are developed. The student uses these and the Pythagorean Theorem to find the unknown sides.

Grade Level: High School and above

Student Time: 30 minutes

Subject Area: Trigonometry

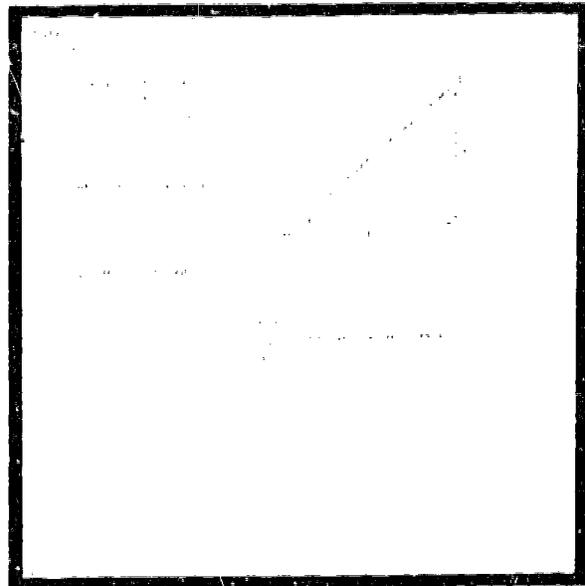
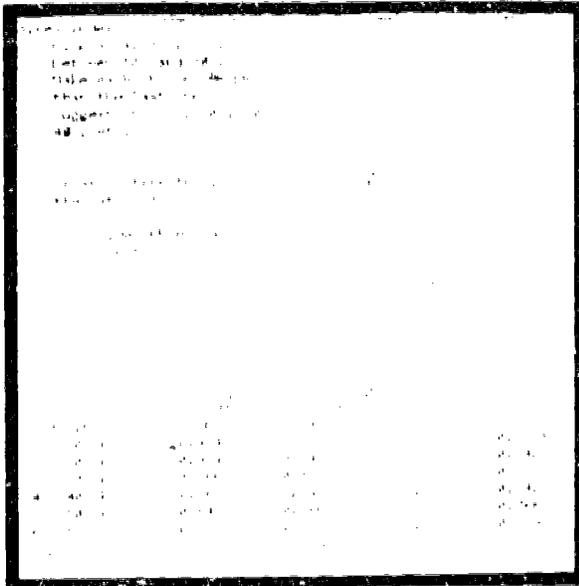
ecs: 2110

Special Notes:

The student gets an index and he can study the sections in any order.

File Name: trig3
The Sine of an Angle

Authors: Paul Thompson, Parkland College, and Robert Baillie, CERL
programmed by Robert Baillie, CERL



Objective:

To provide instruction in using the sine for finding missing sides or angles of a right triangle.

Description:

1. A definition of $\sin A$ is provided and used to find $\sin A$ when the sides are known.
2. The student finds missing parts of a right triangle when the sine of an angle is given. Examples and practice are provided.
3. The student uses tables of sines to find sines or angles when one of them is given.

Grade Level: High School and above

Student Time: 30 minutes

Subject Area: Trigonometry

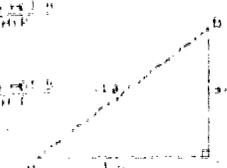
ecs: 3110

File Name: trig4
The Cosine and Tangent of an Angle

Authors: Paul Thompson, Parkland College, and Robert Baillie, CERL
programmed by Robert Baillie, CERL

cos4

Let $\triangle ABC$ be a right triangle with the right angle at C . The side AC is b , the side BC is a , and the hypotenuse AB is c . The angle A is A .



The cosine of A is $\cos A = \frac{\text{side adjacent to } A}{\text{hypotenuse}} = \frac{b}{c}$.

What is $\cos A$ if $b = 3$ and $c = 5$?

What is $\cos A$ if $b = 4$ and $c = 5$?

What is $\cos A$ if $b = 3$ and $c = 4$?

What is $\cos A$ if $b = 4$ and $c = 3$?

What is $\cos A$ if $b = 3$ and $c = 3$?

What is $\cos A$ if $b = 4$ and $c = 4$?

What is $\cos A$ if $b = 3$ and $c = 2$?

What is $\cos A$ if $b = 4$ and $c = 2$?

What is $\cos A$ if $b = 3$ and $c = 1$?

What is $\cos A$ if $b = 4$ and $c = 1$?

What is $\cos A$ if $b = 3$ and $c = 0$?

What is $\cos A$ if $b = 4$ and $c = 0$?

What is $\cos A$ if $b = 3$ and $c = -1$?

What is $\cos A$ if $b = 4$ and $c = -1$?

What is $\cos A$ if $b = 3$ and $c = -2$?

What is $\cos A$ if $b = 4$ and $c = -2$?

What is $\cos A$ if $b = 3$ and $c = -3$?

What is $\cos A$ if $b = 4$ and $c = -3$?

What is $\cos A$ if $b = 3$ and $c = -4$?

What is $\cos A$ if $b = 4$ and $c = -4$?

What is $\cos A$ if $b = 3$ and $c = -5$?

What is $\cos A$ if $b = 4$ and $c = -5$?

What is $\cos A$ if $b = 3$ and $c = -6$?

What is $\cos A$ if $b = 4$ and $c = -6$?

What is $\cos A$ if $b = 3$ and $c = -7$?

What is $\cos A$ if $b = 4$ and $c = -7$?

What is $\cos A$ if $b = 3$ and $c = -8$?

What is $\cos A$ if $b = 4$ and $c = -8$?

What is $\cos A$ if $b = 3$ and $c = -9$?

What is $\cos A$ if $b = 4$ and $c = -9$?

What is $\cos A$ if $b = 3$ and $c = -10$?

What is $\cos A$ if $b = 4$ and $c = -10$?

What is $\cos A$ if $b = 3$ and $c = -11$?

What is $\cos A$ if $b = 4$ and $c = -11$?

What is $\cos A$ if $b = 3$ and $c = -12$?

What is $\cos A$ if $b = 4$ and $c = -12$?

What is $\cos A$ if $b = 3$ and $c = -13$?

What is $\cos A$ if $b = 4$ and $c = -13$?

What is $\cos A$ if $b = 3$ and $c = -14$?

What is $\cos A$ if $b = 4$ and $c = -14$?

What is $\cos A$ if $b = 3$ and $c = -15$?

What is $\cos A$ if $b = 4$ and $c = -15$?

What is $\cos A$ if $b = 3$ and $c = -16$?

What is $\cos A$ if $b = 4$ and $c = -16$?

What is $\cos A$ if $b = 3$ and $c = -17$?

What is $\cos A$ if $b = 4$ and $c = -17$?

What is $\cos A$ if $b = 3$ and $c = -18$?

What is $\cos A$ if $b = 4$ and $c = -18$?

What is $\cos A$ if $b = 3$ and $c = -19$?

What is $\cos A$ if $b = 4$ and $c = -19$?

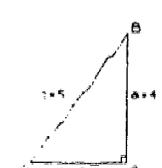
What is $\cos A$ if $b = 3$ and $c = -20$?

What is $\cos A$ if $b = 4$ and $c = -20$?

cos7

A (in $^\circ$)	$\cos A$
53.1 $^\circ$	0.6018
53.2 $^\circ$	0.5994
53.3 $^\circ$	0.5976
53.4 $^\circ$	0.5962
53.5 $^\circ$	0.5948
53.6 $^\circ$	0.5934
53.7 $^\circ$	0.592
53.8 $^\circ$	0.5906
53.9 $^\circ$	0.5892
54 $^\circ$	0.5878

Here is a use of cosines!



Suppose we have a right triangle with these sides:

$a=4$ $b=3$ $c=5$

Then $\cos A = \frac{b}{c} = \frac{3}{5} = 0.6$.

What ANGLE has a cosine of about 0.6?

Name one (from the table) $\rightarrow 53.1^\circ$

Name another $\rightarrow 53.2^\circ$

Since $\cos A = 0.6$, A is BETWEEN 53.1° and 53.2° .
($A = 53.1^\circ$ is better.)

This example shows: IF we KNOW the SIDES, we can FIND the COSINES of the angles, and FROM TABLES we can then FIND the ANGLES!

Objective:

To provide instruction and practice on using the cosine and the tangent to find missing sides or angles of right triangles.

Description:

1. A definition of $\cos A$ is provided and used to find $\cos A$ when the sides are given.
2. The student uses tables of cosines to find cosines or angles when one of them is given.
3. Use of cosine to find missing parts of a right triangle.
4. Finding $\sin A$ by using $\cos(90-A)$ and vice versa. Proof and practice are provided.
5. Definition of $\tan A$, and finding $\tan A$ when the sides are given.
6. Using tables of tangents to find $\tan A$ or A when one is given.
7. Use of tangent to find missing parts of a right triangle.

Grade Level: High School and above

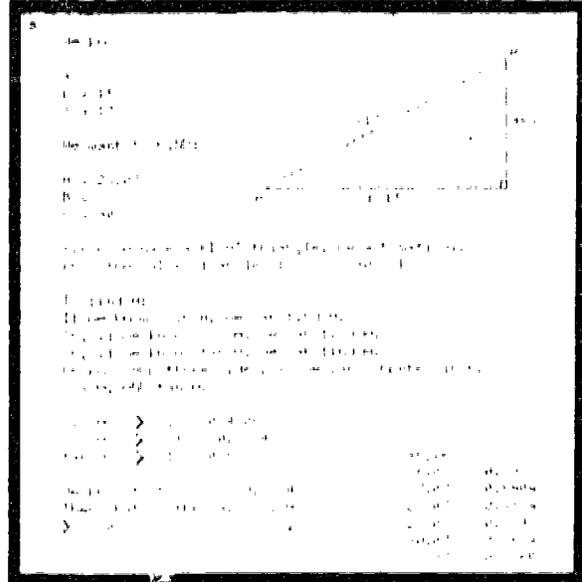
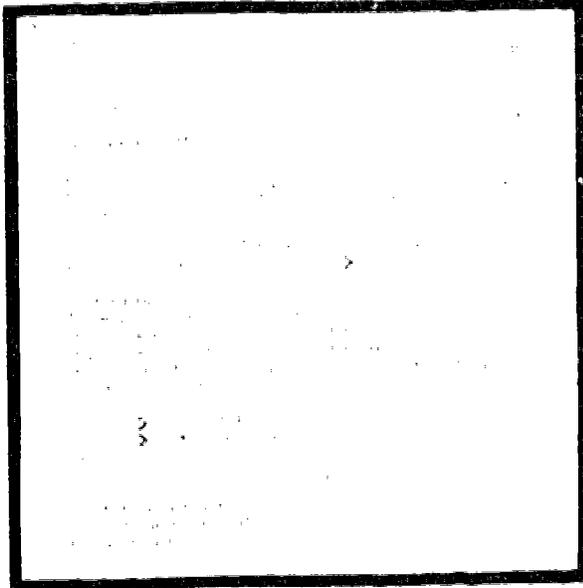
Student Time: 30 minutes

Subject Area: Trigonometry

ecs: 4150

File Name: trig5
Solving Right Triangles

Author: Robert Baillie, CERL



Objective:

To provide a review for the sine, cosine, and tangent of an angle and applications to solving right triangles.

Description:

1. Right triangle problems are provided with the following parts given:
 - a. All three sides
 - b. Two sides
 - c. One side and one acute angle
2. The student is given help in finding the missing parts by breaking the procedure into steps.

Grade Level: High School and above

Student Time: 30 minutes

Subject Area: Trigonometry

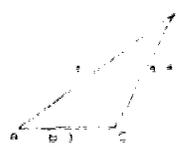
ecs: 4150

Special Notes:

An index is provided so that the student can review the sections in any order.

file Name: trig6
Solving Oblique Triangles

Author: Robert Baillie, CERL



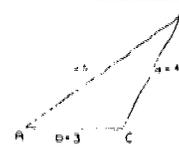
What should we use to find angle A?
(Law of Sines or Cosines) - cosines ok

Write the law of cosines with a "cos A" in it:
 $a^2 = b^2 + c^2 - 2bc \cos A$ ok

GREAT! Now let's rewrite it with "cos A" on the left:
 $\cos A = (b^2 + c^2 - a^2) / (2bc)$ ok

Now YOU put in the KNOWN values of a, b, and c:
 $\cos A = (3^2 + 4^2 - 4^2) / (2 \cdot 3 \cdot 4)$ ok
 $= 0.056$ Then $A = 90$

angle (°)	cos
35.34	0.8158
36.34	0.8056
37.34	0.7951
38.34	0.7844
39.34	0.7734
40.34	0.7623



What should we use to find angle B?
(Law of Sines or Cosines) - cosines ok

Write the law of cosines with a "cos B" in it:
 $b^2 = a^2 + c^2 - 2ac \cos B$ ok

GREAT! Now let's rewrite it with "cos B" on the left:
 $\cos B = (a^2 + c^2 - b^2) / (2ac)$ ok

Now YOU put in the KNOWN values of a, b, and c:
 $\cos B = (3^2 + 4^2 - 4^2) / (2 \cdot 3 \cdot 4)$ ok
 $= 0.056$ Then $B = 36.34$ ok

Write the law of cosines with a "cos C" in it:
 $c^2 = a^2 + b^2 - 2ab \cos C$ ok

$\cos C = (a^2 + b^2 - c^2) / (2ab)$
 $= (3^2 + 3^2 - 4^2) / (2 \cdot 3 \cdot 3)$ ok
 $= 0.8956$ Then $C = 26.38$ ok

FINALLY: How much is angle C?
 $C = 180^\circ - (36.34^\circ + 26.38^\circ)$ ok $C = 117.28^\circ$

Objective:

To introduce the laws of sines and cosines and provide examples and practice in solving oblique triangles.

Description:

- The laws of sines and cosines are presented without proofs but with examples.
- Oblique triangle problems are provided with the following parts given:
 - All three sides
 - Two sides and the included angle
 - One side and two angles
- The student gets help with the algebraic manipulation of the laws as needed in the problems. Answers are given in some places after several mistakes are made.

Grade Level: High School and Above

Student Time: 30 minutes

Subject Area: Trigonometry

ecs: 4720

File Name: trig7
Sine of Angles Greater than 90 Degrees

Author: Robert Baillie, CERL

Table
Sometimes we need the sine or cosine of an angle between 90° and 180°.

Most tables only go up to 90°. Therefore, we need a formula to help us find the sine or cosine of an angle which is beyond the range of the table.

Here is a table of sines from 0° to 180°.

Let's look for a pattern.

angle	sine
0°	0.0000
10°	0.1736
20°	0.3420
30°	0.5000
40°	0.6428
50°	0.7660
60°	0.8660
70°	0.9397
80°	0.9848
90°	1.0000
100°	0.9848
110°	0.9397
120°	0.8660
130°	0.7660
140°	0.6428
150°	0.5000
160°	0.3420
170°	0.1736
180°	0.0000

Tables
Sometimes we need the sine or cosine of an angle between 90° and 180°.

Most tables only go up to 90°. Therefore, we need a formula to help us find the sine or cosine of an angle which is beyond the range of the table.

Here is a table of sines from 0° to 180°.

Let's look for a pattern.

angle	sine
0°	0.0000
10°	0.1736
20°	0.3420
30°	0.5000
40°	0.6428
50°	0.7660
60°	0.8660
70°	0.9397
80°	0.9848
90°	1.0000
100°	0.9848
110°	0.9397
120°	0.8660
130°	0.7660
140°	0.6428
150°	0.5000
160°	0.3420
170°	0.1736
180°	0.0000

Objective:

To teach the student how to use tables to find values of the sine for angles greater than 90 degrees.

Description:

This is a short lesson with exercises which develop the formula $\sin A = \sin(180 - A)$ from the pattern in a table of sine values.

Grade Level: High School and above

Student Time: 5 minutes

Subject Area: Trigonometry

ecs: 568

Special Notes:

This lesson will be expanded to include a similar treatment for cosine.

File Name: word2
Word Problems with Trigonometry

Author: Gary Peltz, City Colleges of Chicago

Objective:

To provide practice in solving word problems.

Description:

1. Given the angles of elevation from two observation points of a tree on the opposite side of a river, the student is asked to generate an equation which can be solved for the width of the river. When he has entered such an equation, he must then find its solution.
2. Several types of help are available: see a general explanation of the procedure to use, have the problem solved, or be stepped through the problem. In the step-through help sequence, the answers can always be obtained by pressing the HELP key.

Grade Level: High School and above

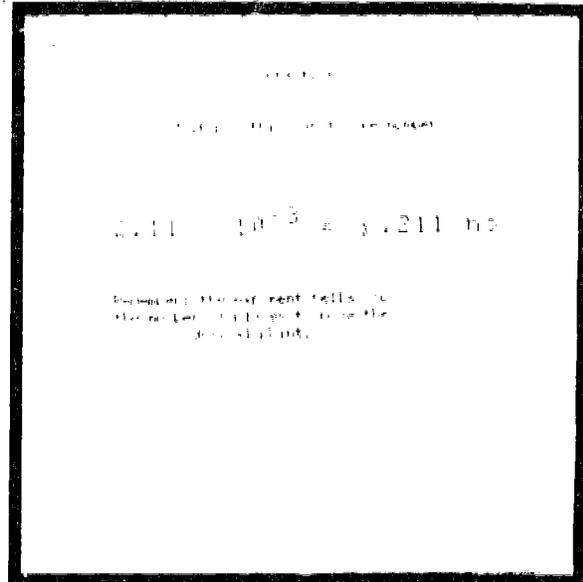
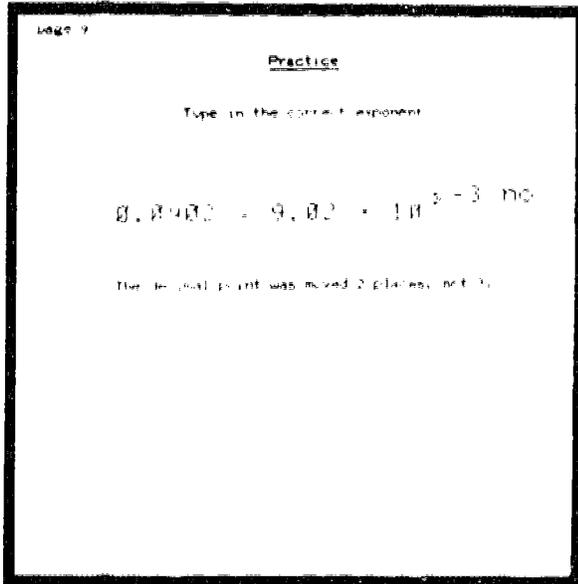
Student Time: 20 minutes

Subject Area: Trigonometry and
Elementary Algebra

ecs: 4362

File Name: scientot
Scientific Notation

Author: Barbara Lederman, CERL
programmed by David Lassner, CERL



Objective:

To provide instruction and exercises on scientific notation.

Description:

1. In the instructional section which precedes the practice exercises, the relationship between the exponent in the power of 10 and moving the decimal point is taught.
2. There are two types of practice exercises:
 - a. Multiply out a number given in scientific notation.
 - b. Fill in the correct exponent in the power of ten so that the number will be in scientific notation.

Grade Level: High School and above

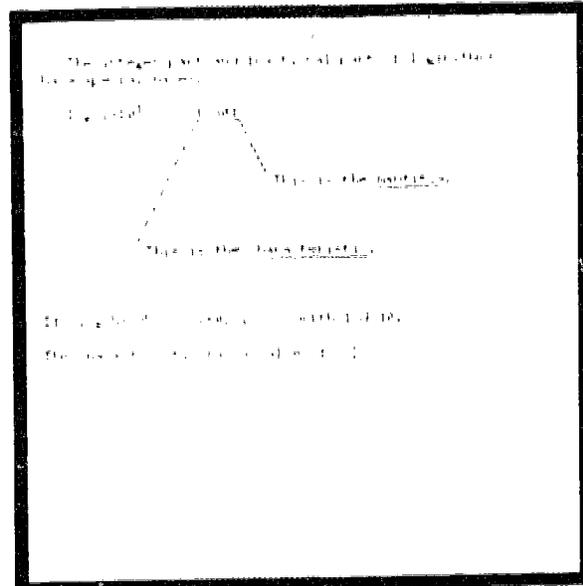
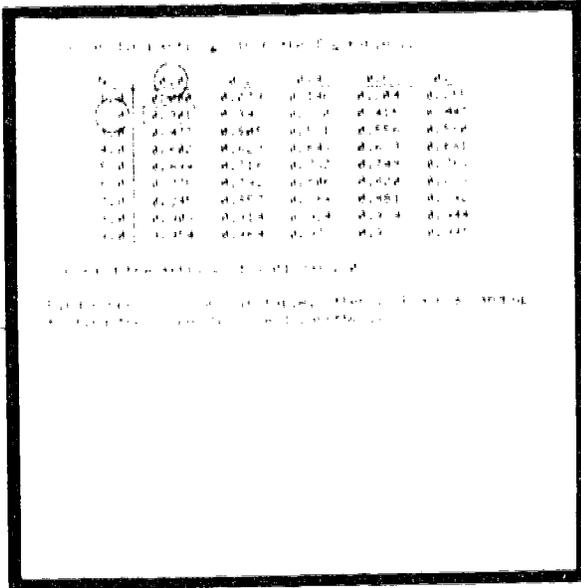
Student Time: 10 - 15 minutes

Subject Area: Arithmetic

ecs: 1873

File Name: cclog
Introduction to Logarithms

Author: Donald Shirer, Valparaiso University



Objective:

To provide an introduction to logarithms and logarithm tables.

Description:

1. The lesson includes instruction and exercises on powers of 10 logarithms, log tables, antilogs, use of logs, and a quiz.
2. There are also two optional topics: construction of log tables, and logarithmic relations between two quantities.

Grade Level: Elementary Algebra

Student Time: 45 minutes

Subject Area: Algebra

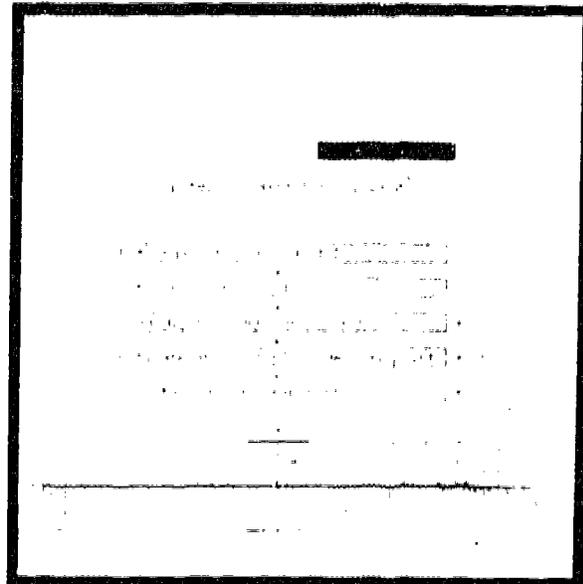
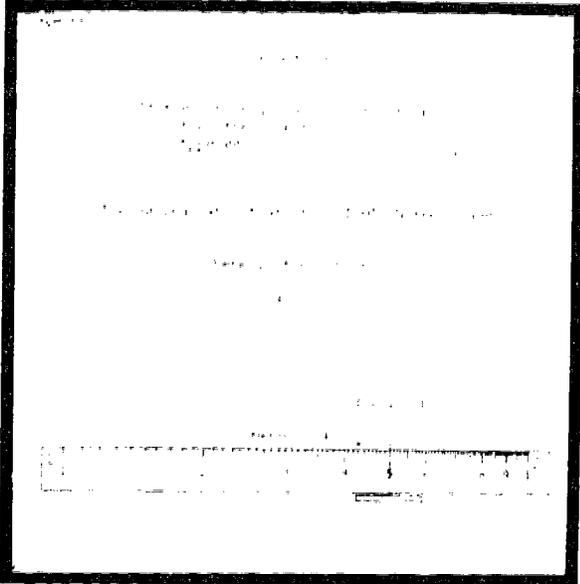
ecs: 5679

Special Notes:

1. Use of on-line calculator is explained and made available.
2. Topics are accessed from an index.

File Name: sr1 (jumpout to sr and scienot)
Slide Rule

Author: Barbara Lederman, formerly of CERL
programmed by David Lassner, CERL



Objective:

To provide instruction and practice in the use of a slide rule for multiplication and division problems.

Description:

1. There are five sections:
 - a. Review of scientific notation
 - b. Reading a slide rule
 - c. Estimating answers
 - d. Multiplication
 - e. Division
2. Each section has instruction and practice drills.
3. A simulated slide rule is used for the instruction. The student uses his own slide rule to work the exercises, with remediation provided by the simulated slide rule.

Grade Level: Technical math or
physical science courses

Student Time: 3.5 hours

Subject Area: Slide Rule

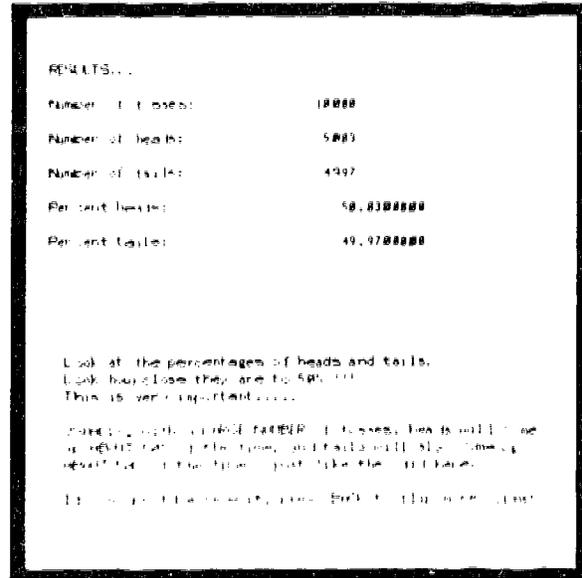
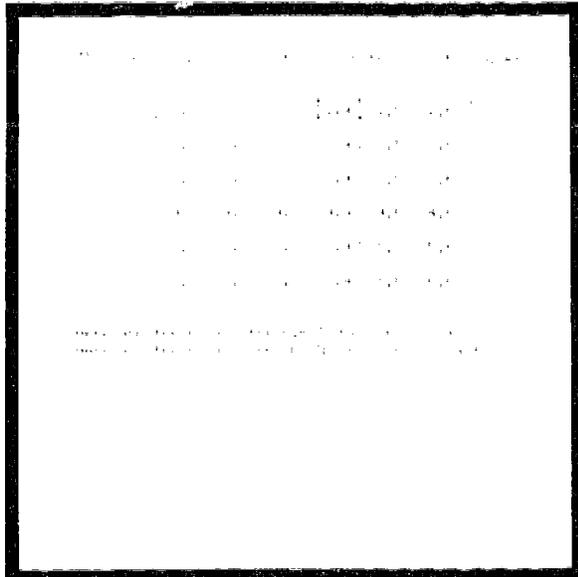
ecs: sr: 3351
sr1: 5994
scienot: 1873

Special Notes:

The student needs his own slide rule to work the exercises in sections four and five.

File Name: ccprob
Introduction to Probability

Author: Robert Baillie, CERL



Objective:

To acquaint the student with the meaning of randomness and probability.

Description:

1. Randomness experiment shows that randomness involves unpredictability (the outcome of a coin toss can not always be predicted in advance).
2. Formal definition of probability is given, followed by examples which use the definition to calculate the values of various probabilities.
3. Example to show that impossible events have probabilities of 0, events that are certainties have probabilities of 1, and all other events have probabilities between 0 and 1.
4. Coin and dice throwing experiments (see Special Notes).
5. Explanation of the fact that, if 100 consecutive tosses of a balanced coin come up "heads," the probability that the 101st toss will also be "heads" is still $1/2$.
6. Examples show the difference between independent and dependent events, and the product law for independent events is obtained from examples.

Grade Level: Community College

Student Time: 60 minutes

Subject Area: Elementary probability

ecs: 6200

Special Notes:

Two sections simulate coin and dice throwing experiments. The student can see what is likely to happen when a large number (up to a billion) of coins or dice are tossed.

File Name: mathcc
Community College Math Index

Contact: Louis V. DiBello, CERL

Objective:

To provide an on-line index of all community college math materials which are currently available for use, inspection, or criticism.

Description:

This is an index allowing easy access to basic mathematics materials. It is periodically updated, and it contains the current status of lessons as "preliminary version," "under review," or "classroom tested."

Grade Level: Adult Education and
Community College

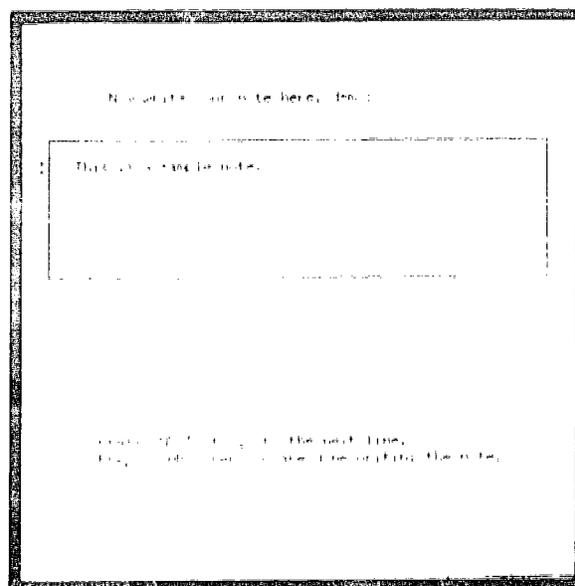
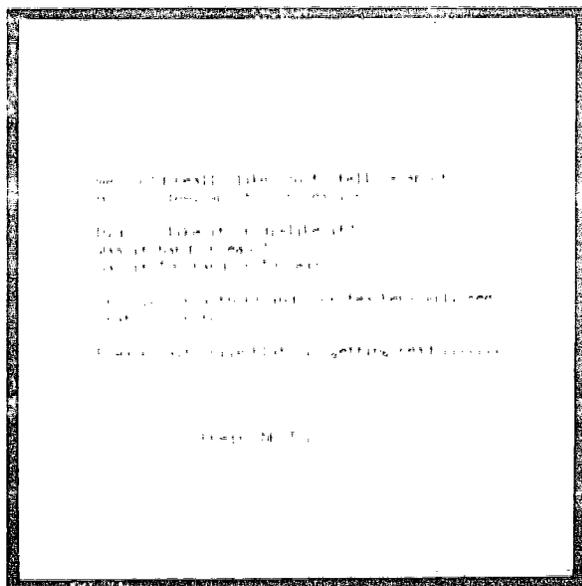
Student Time: not applicable

Subject Area: Mathematics

ecs: 2349

File Name: studnotes

Author: Tamar Abeliovich Weaver, CERL
 adapted from the Elementary Math Group lesson "kidnotes"



Objective:

To let the student write notes or comments on the lessons he has completed.

Description:

1. The student is given a blank note space and a simple editor to write notes or comments. His name, course, date and time are automatically saved along with the lesson the student has come from.
2. The note is stored in a dataset and these are readable by instructors and authors through lesson "studnotes".

Grade Level: not applicable

Student Time: not applicable

Subject Area: not applicable

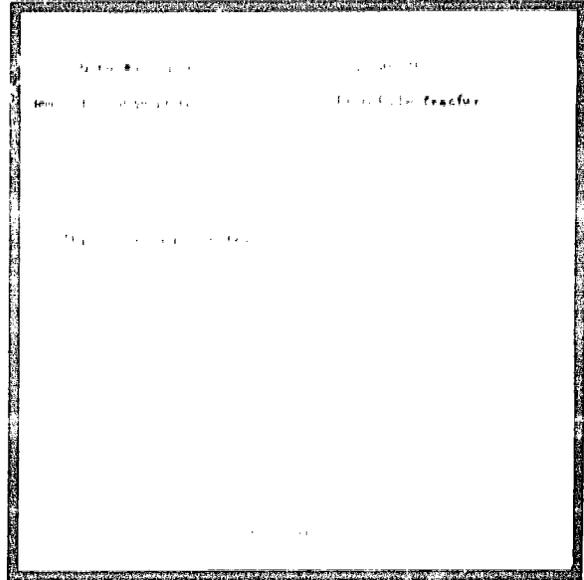
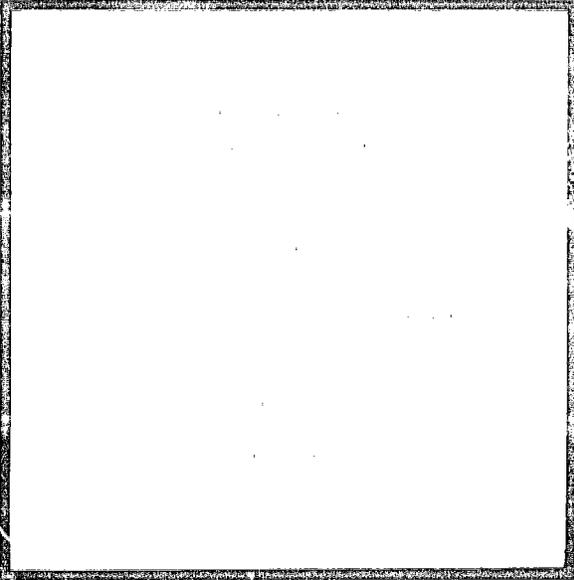
ecs: 79'

Special Notes:

In order to make comments lesson available at the end of a lesson, the author must insert a short unit of code in the lesson. For more information, contact Tamar Abeliovich Weaver.

File Name: studnotesr

Author: Tamar Abeliovich Weaver, CERL
adapted from the Elementary Math Group lesson "kidnotes"



Objective:

To allow reading of student's comments about lessons that have been collected via lesson "studnotes".

Description:

Instructors and authors are able to read notes including the information about the student and which lesson he came from.

Grade Level: not applicable

Student Time: not applicable

Subject Area: not applicable

ecs: 1568

Special Notes:

This file must be periodically emptied to allow for more notes. A file of copies of student notes is kept for notes that have been deleted. For information, contact Tamar Abeliovich Weaver.

File Name: mathnotes
Math Notes

Contact: Louis V. DiBello, CERC

Objective:

To provide a communication file for authors, users, instructors, and other personnel interested in the community college math group.

Description:

Space is available for messages to be written to individuals or groups. Messages will be maintained until they are no longer needed and then deleted.

Grade Level: not applicable

Student Time: not applicable

Subject Area: not applicable

ecs: 5830